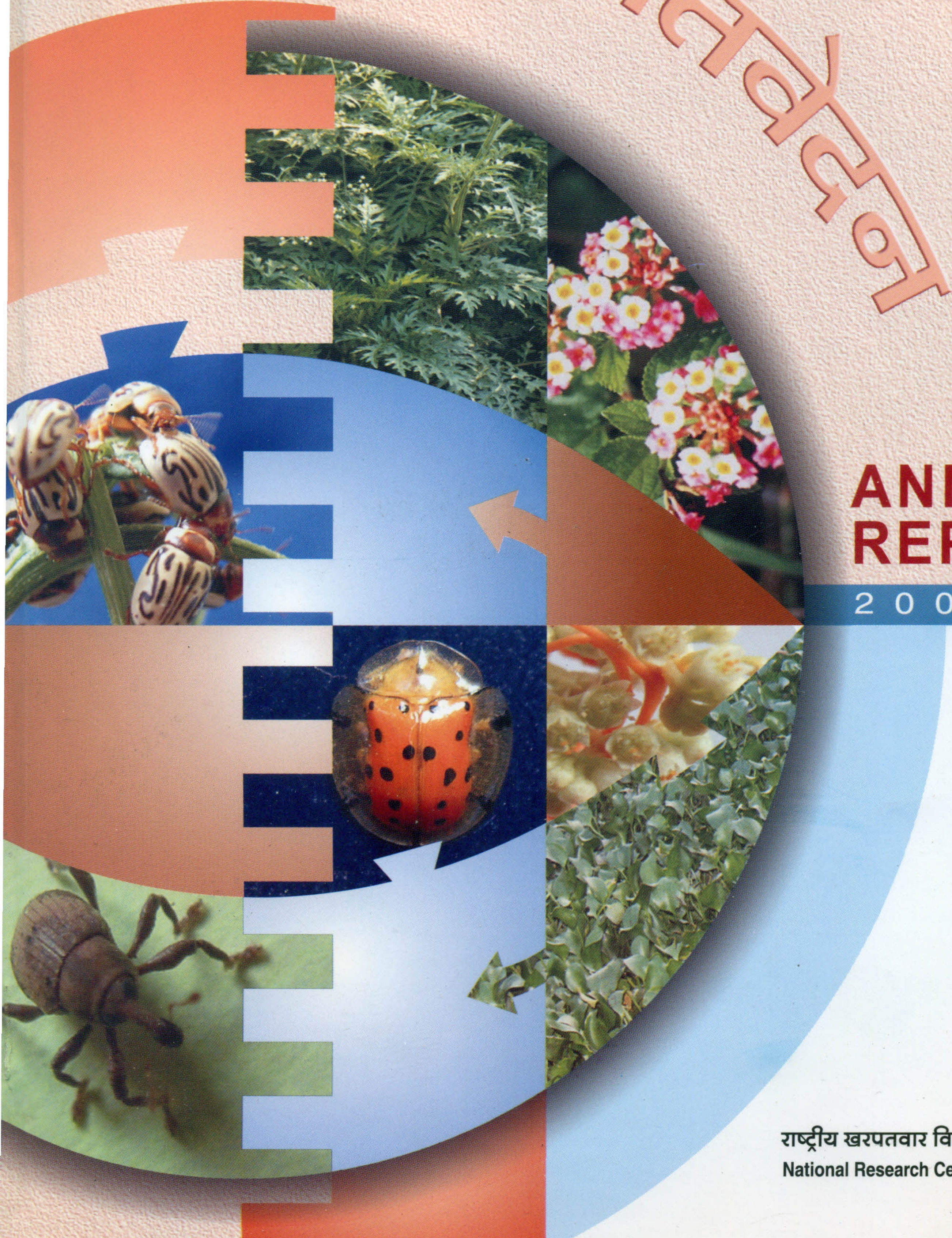
वार्षिक प्रतिवेदन



ANNUAL REPORT

2003-04

राष्ट्रीय खरपतवार विज्ञान अनुसंधान केन्द्र
National Research Centre for Weed Science
Jabalpur - 482 004

वार्षिक प्रतिवेदन
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भाकृ अनुप
ICAR

राष्ट्रीय खरपतवार विज्ञान अनुसंधान केन्द्र

NATIONAL RESEARCH CENTRE FOR WEED SCIENCE
JABALPUR (M.P.)

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Preface

NRC for Weed Science being the nodal Centre for research and training in the field of Weed Science continues to provide leadership in research, training and coordination activities ion the country. Despite increased awareness about weeds, they continue to inflict huge losses on crop productivity. While modern high input agriculture is considered responsible for this, the special traits associated with weeds are no less important for their dominance. Significant findings in the areas of identifying competitive crop cultivars, weed smothering intercrops, non-chemical and biological methods of weed control, weed dynamics in crops and cropping systems, management of parasitic weeds, allelopathic studies, testing of new herbicides and transfer of improved weed control technologies have emerged during the year under report..

A memorandum of Agreement (MoA) was signed with Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur for collaboration in research, education and extension in weed science. In keeping with the trend of the past years, the Centre offered training in research on weed management to about 17 research scholars and students belonging to different Universities. The Centre has also bagged two projects under AP Cess Fund scheme of ICAR and many are in the pipeline.

In view of the major role played by the rural womenfolk in weeding operations, a training programme was organized to appraise them of the various ergonomical weeding tools developed by the Centre. The Centre also organized *kisan goshtis*, participated in *kisan melas* organized by other organizations and helped in popularizing the improved weed management technologies. In addition public awareness campaign on the management of parthenium and water hyacinth were also held. It has been a very satisfying year in the area of publications. The Centre brought out five technical bulletins and a record number of 28 extension bulletins both in English and Hindi.

Looking at the problem of alien invasive weeds, a National seminar on 'Alien Invasive Weeds in India' was organized at Assam Agricultural University, Jorhat from April 27-29, 2003 coinciding with the group meeting of AICRP on Weed Control. With a view to create public awareness, attractive posters on eight invasive weeds were also brought out which have been highly appreciated and are in great demand. As in previous years special drive was made in creating public awareness of problematic weed Parthenium. A record number of Mexican beetle (*Zygogramma bicolorata*) the bio-control agent of parthenium was distributed free of cost in several places throughout the country.

The new initiative of collecting, cataloguing and conservation of characterizing seeds of major weeds of the country has made good progress with nearly 140 collections made so far.

I have great pleasure in presenting the research achievements of the National Research Centre for Weed Science for the year 2003-04. I hope that the report would give a good insight into the world of weeds-their diversity, abundance, competition and their response to various weed management practices. I took forward to receiving comments on this report in particular or on weeds in general.

N.T. Yaduraju
Director

Acknowledgement

The Centre continues to enjoy the good will, support and encouragement from Dr. Mangala Rai, Secretary, DARE and Director General, ICAR for his unstinted support in the development of the Centre for which the Centre is highly grateful. Thanks are also due to Dr. J.S. Samra, Deputy Director General (NRM) and Dr. Gurbachan Singh, Assistant Director General (Agro), NRM for their valuable advice and guidance from time to time. The keen interest and suggestions by Dr. J.S. Kolar, Chairman and other members of the Research Advisory Committee in guiding the research activities of the Centre is greatly acknowledged. The untiring enthusiasm in conducting the research and supplying the material for this report by the scientists of the Centre is deeply appreciated. The painstaking efforts of the editorial committee comprising of Dr. B.T.S. Moorthy, Dr. R.P. Dubey and Dr. M.B.B. Prasad Babu in editing the report is deeply acknowledged. Thanks are also due to Dr. M.S. Raghuvanshi and Mr. Sandeep Dhagat and other technical and administrative staff for their help in bringing out this publication.

N.T. Yaduraju
Director

Contents

मुख्य अंश

राष्ट्रीय खरपतवार विज्ञान अनुसंधान केन्द्र में वर्ष 2003-04 के दौरान अनुसंधान गतिविधियाँ मुख्यतः फसलों के प्रतियोगी किस्मों, अंतःवर्तीय फसलों का खरपतवारों पर प्रभाव, भूमि सूर्यीकरण, जैवकीय खरपतवार नियंत्रण, सस्यक्रमों का खरपतवारों पर प्रभाव, शाकनाशियों का परीक्षण आदि पर आधारित थी। इन गतिविधियों के मुख्य शोध परक तथ्य इस प्रकार प्रस्तुत हैं।

- एक परीक्षण के दौरान, चने की किस्मों जैसे जेजी-11 व जेजी-315 एवं गेहूं डब्ल्यू एच-145, डी एल-803-3 व राज-33765 की किस्में खरपतवारों से प्रतियोगिता करने में एवं ज्यादा उपज देने से सक्षम पाई गई ।
- मटर की ज्यादा उपज वाली जल्द बढ़वार व एवं फैलने वाली किस्म डब्ल्यू एच-145, डी एल-803-3 व राज-33765 जे पी 885, को खरपतवारों से प्रतियोगिता करने एवं ज्यादा उपज देने हेतू उपयोगी पाया गया । तथा इसके साथ-साथ खरपतवार नियंत्रण लागत में भी कमी आती है ।
- गेहूँ की किस्मों जैसे सी-306 एवं एच आई-1077 में 2.8 प्रतिशत हिरनखुरी से ग्रसित होने के बावजूद भी उपज में कम हानि दर्ज की गई ।
- उपरांव धान में, ढ़ेचा उगाने के साथ-साथ 2,4-डी का 1.0 किग्रा/हे की दर से छिड़काव करने पर खरपतवार प्रबंधन में कम लागत आती है ।
- धान की फसल में, नये शाकनाशी जैसे हेलोसल्फ्यूरान मिथाइल (60 ग्रा/हे 6-9 दिन बाद) तथा ऑक्साडायजान (100 ग्रा/हे) के छिड़कने से खरपतवार नियंत्रण एवं ज्यादा उपज दर्ज करने में प्रभावी पाये गये ।
- प्याज में, आपकी आक्सीफ्लूरोफेन या पेन्डीमिथालिन का एक निंदाई के साथ छिकाव करने से प्याज की 63 क्विटल उपज/हे तक दर्ज की गई है ।
- ओस एवं हल्की बरसात में गेहूं की फसलों में खरपतवार हेतु क्लोडिनाफाप नामक शाकनाशी का प्रभाव और बढ़ता है ।
- गेहूं की फसल में क्लोडिनाफाप के साथ 2,4-डी या, मेटसल्फयूरॉनडायकेम्बा के छिड़कने से खरपतवारों पर ज्यादा नियंत्रण पाया गया एवं ज्यादा उपज दर्ज की गई ।
- रामतिल, चना, अलसी एवं मसूर की फसल में पेन्डिमिथालिन के उपयोग से अमरबेल (कसक्यूटा) नामक परपोषी खरपतवार का प्रभावी एवं सुरक्षित ढंग से नियंत्रण दर्ज किया गया ।
- एनीलोफास नामक शाकनाशी की तुलना में, ब्यूटाक्लोर एवं प्रेटिलाक्लोर शाकनाशी एजोला के लिए काफी विषाक्त साबित हुये । इससे हल्की बढ़वार, कुल नत्रजन एवं क्लोरोफिल में अर्थपूर्ण कमी आती है ।
- यूफोरबिया जेनीकुलाटा नामक खरपतवार को सोयाबीन को ज्वार या मक्के के फसल चक्र को अपनाकर सोयाबीन में मुख्य खरपतवार यूफोरबिया जेनीफलाता का प्रबंध किया जा सकता है ।
- ब्यूटाक्लोर के लगातार उपयोग करने से उपरांव धान-गेहूं के सस्यक्रम में सवां, निरूरी,, फाइसेलिस मिनीमा एवं कामेलिना ज्यादा पाये जाते है । वहीं धान-गेहूँ के क्रम में मोथा एवं आल्टरनेनथेरा ज्यादा दर्ज किये गये ।
- सोयाबिन-गेहूं सस्यक्रम में, मेडिकागो एवं बिसिया की संख्या में अर्थ पूर्ण कमी दर्ज की गई ।
- सरसों की फसल में, बारले एवं बरसीम को अंतःफसलो के रूप में लेने से खरपतवारो का प्रभावी नियंत्रण पाया गया ।
- जीरो टीलेज नामक तकनीक से खरपतवारो की ग्रसिता कम दर्ज की गई वहीं कामेलिना एवं वाइल्ड ओट की संख्या में वृद्धि पाई गई ।
- आलू की कतारो में धान के पुआल एवं जलकुम्भी के उपयोग से मिटटी चढ़ाने एवं मेट्रीब्यूजीन की तुलना में आलू की उपज में क्रमशः 35 एवं 68 प्रतिशत की वृद्धि दर्ज की गई ।

- तिल की फसल में, गोबर की खाद के बगैर एवं इसके रहते 45 दिनों तक भूमि सूर्यीकरण करने से सवां, मोथा, फाइलेन्थस, कामेलिना, आलटरनेनेथेटा एवं मोलीगो नामक खरपतवारो की संख्या में अर्थपूर्ण कमी दर्ज की गई ।
- आन्ध्रप्रदेश में एक सर्वेक्षण के दौरान यह पाया गया कि करीब 7200 हे. भूमि में जहां दालों की फसलें ली जाती है जहां बिसिया सटाईवा नामक खरपतवार के प्रकोप से लगभग 50 से 100 प्रतिशत उपज की हानि हो रही है ।
- जबलपुर के तालाबों के सर्वेक्षण के दौरान, टरटल बीटल केसीडा स्पी को ऐलीगेटर वीड को पत्ति रहित करता पाया गया ।
- एक अध्ययन में यह पाया गया कि शाकनाशी जैसे मेटसल्फयूरान, 2,4-डी एवं ग्लाईफोसेट वीड कंट्रोल के दोरान जीवों एवं मछलियों हेतू काफी सुरक्षित पाये गये साथ-साथ ।
- नीम की पत्तियों के अवशेष एलीगेटेर वीड (आल्टरनेनथेरा फिलीक्सीरायड) की पत्तियों पर नराकात्मक प्रभाव डालता है । प्रांरभ में यह गतिविधि बढ़ती है फिर तेजी से घटती है ।
- डिक्कन प्लेटयू में धान पर आधारित सस्य क्रम में धान के साथ मछली पालन उपयोग करने से खरपतवारों में क्रमशः 26 एवं 38 प्रतिशत की कमी पहले एवं दूसरे साल दर्ज की गई ।
- उपरावं धान में, ब्यूटानिल, आलमिक्स एवं फिनाक्साप्राप नामक शाकनाशी खरपतवार नियंत्रण हेतू प्रभावी पाये गये ।
- आसाम एवं बंगाल प्लेन में, उपरांव धान में काउपी को अंतः फसल के रूप में लेने एवं कटाई करने से खरपतवारों पर प्रभावी नियत्रंण पाया गया ।
- उत्तरी प्लेन क्षेत्र, में गेहूं को फर्व में बोने से सामान्य बुवाई के समानान्तर उपज प्राप्त होती है तथा फेलेरिस माइनर पर प्रभावी नियंत्रण भी प्राप्त होता है ।
- कपास में, पेन्डिमिथालिन (1.5 किग्रा/हे) के साथ ग्लायफोसेट के सुरक्षित उपयोग से सबसे ज्यादा कपास की उपज प्राप्त हुई ।
- गैर-भूमि सूर्यीकरण एवं स्टेल सीड बेड की अपेक्षा भिण्डी में भूमि सूर्यीकरण करने से ज्यादा फल उत्पादन प्राप्त हुआ ।
- उत्तरी प्लेन क्षेत्र में लम्बी अवधि वाले धान-गेहूं सस्यक्रम से सवां फिर से पनपने लगता है ।
- नहरो एवं तालाबों में ग्लाईफोसटेक इस्तेमाल से कमल के पौधो को प्रभावी रूप से नष्ट किया जा सकता है ।
- आलग्रीप को 50 ग्रा/हे. की दर से उपयोग करने से जलकुम्भी का प्रभावी नियंत्रण किया जा सकता है ।
- गन्ने में, 2,4-डी (सोडियम साल्ट) का 5 ग्राूयूरिया का (20 ग्रा/ली. यूरिया) उपयोग करने से स्ट्राइगा का नियंत्रण संभव है ।
- मक्के में, एट्राजिन नामक शाकनाशी का छिड़काव 1.0 किग्रा/हे की दर से करने पर जमीन में यह 60 दिन तक बना रहता है । यदि इसकी दर दुगनी करने पर यह 80 दिन तक रहता है उपरांव धान में ब्यूटाक्लोर को चार साल तक लगातार उपयोग करने पर भी इसका उपरांव धान पर कोई प्रभाव नहीं पड़ता । वही सल्फोनिलयूरिया शाकनाशी के छिड़काव से 15 दिनो बाद भी वेक्टीरिया की संख्या में अर्थपूर्ण कमी आती है ।

Weed competitive cultivars

Chickpea varieties *viz*. JG-11 and JG-315 were found promising for weed competitive abilities and higher seed yields.

Three wheat varieties WH-147, Raj 33765 and DL-803-3 were promising with higher yields and weed competitive abilities.

JP-885, a high yielding, tall, quick growing and spreading type pea cultivar was found to be the best in terms of weed competitiveness and seed yield in a field trial under sub-optimal management condition and can reduce the cost of weed control in pea.

Wheat-C-306 recorded the least reduction in yield due to field bindweed infestation (2.86%), which was closely followed by the variety HI-1077 (5%).

Weed smothering intercrops

In direct-seeded rice, intercropping of dhaincha and killing it by 2,4-D (1.0 kg/ha) at 30 days after sowing is a cost effective strategy for weed management.

Promising herbicides

In transplanted rice, application of new herbicide halosulfuron methyl (NC319) at 60 g/ha applied at 6-9 DAT and oxadiargyl (100 g/ha) proved very effective for weed control and produced higher yield.

Oxyfluorfen (200 g/ha) or pendimethalin (1.0 kg/ha) followed by one hand weeding was found to reduce weed infestation in onion resulting in higher bulb yield (63 q/ha).

Plant mixtures (crop and weed grown in mono- and mixed-culture) grown *in vitro* with minimum aseptic conditions and in the presence of antibiotics (tetracycline, streptomycin and bavistin) in Hogland's solution proved to be an ideal system for proving the allelopathic effect of crops and weeds in mixed culture as compared to their respective controls on mono and mixed culture.

Fog and simulated rain enhanced the activity of clodinafop on wild oat in wheat.

Clodinafop (60 g/ha) fb 2,4-D (500 g/ha) effectively controlled both grassy and broadleaved weeds and proved higher grain yield of wheat.

In wheat, application of metsulfuron + dicamba (4+ 500g/ha) effectively reduced the the population of field bind weed and other broad leaf weeds.

Application of pendimethalin (1.0 kg/ha) as pre-emergence was found safe and effective against *Cuscuta* in niger, chickpea, linseed and lentil.

Butachlor and pretilachlor were found very toxic to both *Azolla* and *blue green algae* component, which reduced its growth and multiplication, total chlorophyll, total nitrogen. Anilofos was found to be relatively very less toxic to the both components of the symbionts and can be used where *Azolla* is to be released as the sole or partial source of organic nitrogen.

Cropping system

Euphorbia geniculata (a major weed in soybean) could be managed effectively by rotation with sorghum or maize.

Weed flora shift under continuous use of herbicides like butachlor in direct-seeded and transplanted rice- whea cropping systems showed significant occurrence of *Echinochloa colona*, *Phyllanthus niruri*, *Physalis minima* anc *Commelina communis* were recorded under direct seeded rice-wheat cropping system, where as, *Cyperus iria* anc *Alternanthera sessilis* were recorded more under transplanted rice -wheat cropping system.

Infestation of *Medicago hispida* and *Vicia sativa* declined under soybean-wheat system as compared to direct-seedec rice-wheat cropping systems, whereas cropping systems did not affect weeds like *Avena ludoviciana, Phalaris minoi* and *Cichorium intybus*.

Intercrops *viz*. barley, oat and berseem grown with the main crop of mustard were effective in suppressing the weeds appearing in mustard crop. Highest mustard yield was obtained from mustard + berseem intercropping combination (1998 kg/ha).

Tillage

Zero tillage significantly reduced the weed infestation and resulted in higher yields of both wheat and linseed, resulting reduced population of *Phylanthus* spp, and increased that of *Commelina* spp..

Zero tillage planting reduced the infestation of *Phalaris minor*, *Medicago hispida* and *Chenopodium album*, but increased the problem of wild oat (*Avena sterillis* ssp. *ludoviciana*).

In potato, mulching with rice straw and water hyacinth was found to be superior to conventional earthing up and metribuzin treatments and consequently increased the tuber yield of potato by 35 and 68%, respectively.

Soil solarization

In sesame, soil solarization for a period of 45 days with FYM and without FYM checked completely the emergence oi *Echinochloa colona*, *Cyperus iria*, *Phyllanthus niruri*, *Commelina communis*, *Alternanthera sessilis*, *Physalis minima* and *Mollugo stricta*.

Survey

Vicia sativa is posing problem in the rice fallow pulses in an area of about 7200 ha covering three north coastal districts of A.P namely Srikakulam, Vizianagaram and Visakhapatnam. The yield losses are reported to be between 50-100% and the crop produce is also fetching lower price due to contamination by the weed seeds.

Turtle beetle *Cassida* sp. nr *enervis* was found to defoliate the alligator weed during August to September in many ponds.

Impact of metsulfuron-methyl on bio-agent and fish in relation to alligator weed control proved most effective and safe followed by glyphosate and 2,4-D.

Phytotoxicity of quinol on *Chara* sp, *Apomogeton minor*, *Ceratophyllum demersum* and *Hydrilla verticillata* were studied outdoors to find precise lethal concentration of the allelochemical for the submerged aquatic weeds. The quinol was lethal to rice (*Oryza sativa* var. *kranti*) at and above 5 mM. The allelochemical was found to be lethal to the crop at a concentration much higher than the lethal concentration to *Chara* sp. There might be such selective toxicity and may form basis of probable use of allelochemicals for the weed management.

The neem (*Azadirachta indica* A. Juss.) leaf residue at lethal concentration affected enzymes of oxidative stress in the leaves of alligator weed (*Alternanthera philoxeroides*). There was initial spurt in activity of the enzymes. However, subsequently it declined rapidly.

AICRP-WC

Weed management in rice-based farming system conducted at Deccan Plateau revealed that inclusion of fish (rice + fish) in rice culture reduced the weed density by 26% and 38% during the first and second years.

In direct-seeded rice, butanil (4 l/ha at 10 DAS), almix (4g/ha) and fenoxaprop (60 g/ha) were found effective.

Intercropping of cowpea and harvesting it for fodder at 30 DAS controlled the weeds effectively in direct-seeded rice in Assam and Bengal Plain Hot Humid Region.

In Northern Plain Region, sowing of wheat on furrow irrigated raised bed (FIRB) recorded almost similar grain yield (4085 kg/ha) to that obtained under flat system of sowing (3961 kg/ha) with low incidence of *P. minor*.

In cotton, pre-emergence application of pendimethalin (1.50 kg/ha) followed by a protected spraying of glyphosate (0.5%) gave maximum yield.

Soil solarization gave significantly higher fruit yield of okra as compared to stale seedbed technique and non-soil solarization.

Long term study in rice - wheat system at Northern Plain Region revealed the resurgence of *E. crusgalli*. Continuous use of anilofos increased the population of *Caesulia auxillaris* and *Cyperus iria* but provided good control of *Ischaemum rugosum*.

Application of glyphosate (at 1 %) effectively controlled lotus (*Nilumbo* spp.) in canals.

Eichhornia crassipes could be effectively controlled by applying Algrip (50 g/ha).

Post-emergence application of 2,4-D sodium salt (5g) + urea (20g/l water) effectively reduced the density of *Striga asiatica* in sugarcane.

Herbicide residues

In maize, atrazine (1.0 kg/ha) persisted up to 60 DAS and 2.0 kg/ha up-to 80 DAS. There was no effect on subsequent crops. Four years continuous application of butachlor in rice has no residual effect in soil and grain. Residual effect of sulfonylurea herbicides showed significant decrease in the population of bacteria and *Azotobactor* after 15 days.

Persistence of herbicide in water

In Deccan Plateau region, persistence of paraquat in water samples showed a declining trend after spray. Nearly 80-90% of applied paraquat degraded with in eight days after application. Ground water samples collected from several tube wells from the fields in Punjab where farmers had applied isoproturon in wheat under rice-wheat system for the last many years did not indicate any isoproturon residue.

MANDATE

- To undertake basic and applied researches for developing efficient weed management strategies in different agro-ecological zones;
- To provide leadership and coordinate the network research with State Agricultural Universities for generating location-specific technologies for weed management in different crops, cropping and farming systems;
- To act as a repository of information in weed science;
- To act as a centre for training on research methodologies in the areas of weed science and weed management;
- To collaborate with national and international agencies in achieving the above mentioned goal;
- To provide consultancy on matters related to weed science.

Introduction

Since times immemorial weeds are considered to be an important factor in the management of all terrestrial and aquatic resources besdies agriculture. In view of the severity of the weed problems, a Coordinated Weed Control Scheme was initiated as early as 1952. Later in 1978, to intensify the research work, an All India Coordinated Research Program (AICRP) on Weed Control was launched. To further consolidate the weed management research in India, the National Research Centre for Weed Science (NRCWS) was set up in 1989 as a nodal centre for basic as well as applied research under the aegis of ICAR. The Centre also coordinates the activities of the AICRP-WC with a network of 22 cooperating centres located in different agro-climatic zones covering the entire country. The Centre has a well-qualified and multidisciplinary team of scientists engaged in different aspects of weed management research. The Centre is located between 22.49° and 24.8° North latitude, 78.21° and 80.58° East longitude and at an altitude of 411.78 metres above the mean sea level. Jabalpur comes under the agro-climatic region of Kymore Plateau and Satpura Hills and lies in the rice-wheat cropping zone of the state.

Salient research findings in the past

An exhaustive weed survey of all the states has been completed. A national weed data base is being prepared.

Based on the multi-disciplinary and multi-location trials conducted in different agro- climatic zones, herbicide recommendations for various crops and cropping systems have been made.

The Mexican beetle, *Zygogramma bicolorata* - an ecofriendly bio-control agent for controlling *Parthenium* is being popularized throughout the country. The beetles are supplied free of cost to interested people.

Exotic weevil, Neochetina spp. has been found to be effective in controlling the obnoxious aquatic weed, water hyacinth (*Eichhornia crassipes*).

Planting of marigold and *Cassia serecia* remarkably inhibited the emergence and growth of Parthenium.

Continuous use of butachlor in rice and isoproturon in wheat under rice-wheat system reduced the densities of *Echinochloa colona* in rice and P*halaris minor, Cichorium intybus, Chenopodium album* in wheat but the problem of *Commelina communis, Cyperus iria* in rice and *Chenopodium ficifolium* in wheat increased.

Summer ploughing followed by glyphosate application at 4-6 leaf stage in the month of April successfully controlled infestation of *Saccharum spontaneum* (Kans) during *kharif* season.

Soil solarization during April-May proved to be a suitable non- chemical weed control measure for effective control of several annual weeds.

Intercropping of cowpea in maize and direct - seeded rice has been found to suppress weed growth effectively.

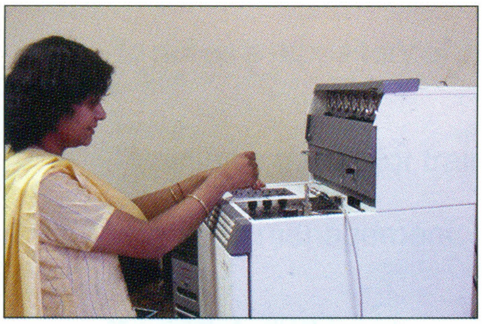
In rice wheat system zero-tillage in wheat reduces the population of *Phalaris minor* whereas wild oat population increases.

Pre-emergence application of pendimethalin 1.0 kg/ha provided satisfactory control of dodder (*Cuscuta* spp.) in lentil, linseed and chickpea.

A power-driven aquatic weeder has been designed and developed for management of aquatic weeds.

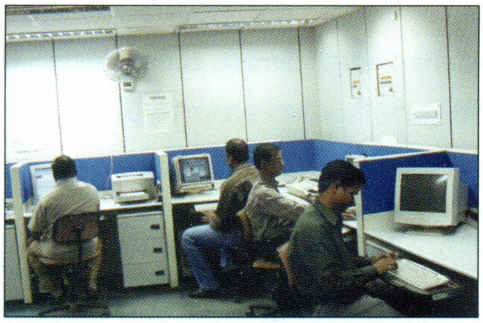
A wick applicator has been developed for application of non- selective herbicides in standing crops.

Monitoring of herbicide residues at national level has indicated that the herbicides applied as per recommendations did not contaminate soil, water or food.



Laboratories

The Centre has well equipped laboratories having sophisticated instruments like HPLC, GLC, micro-processor based UV- visible spectrophotometer, universal research microscope with photographic attachment, stereo zoom research microscope, high speed refrigerated centrifuge, Millipore filter assembly, automatic weather station besides other commonly used scientific equipments.



Aris Cell

ARIS Cell

Centre's ARIS cell is presently equipped with one server and four PCs, two scanners, three laser printers etc., with latest software. It has Internet facility with five nodes. In addition, all the scientists have also been provided with individual computers.

Centre's Library

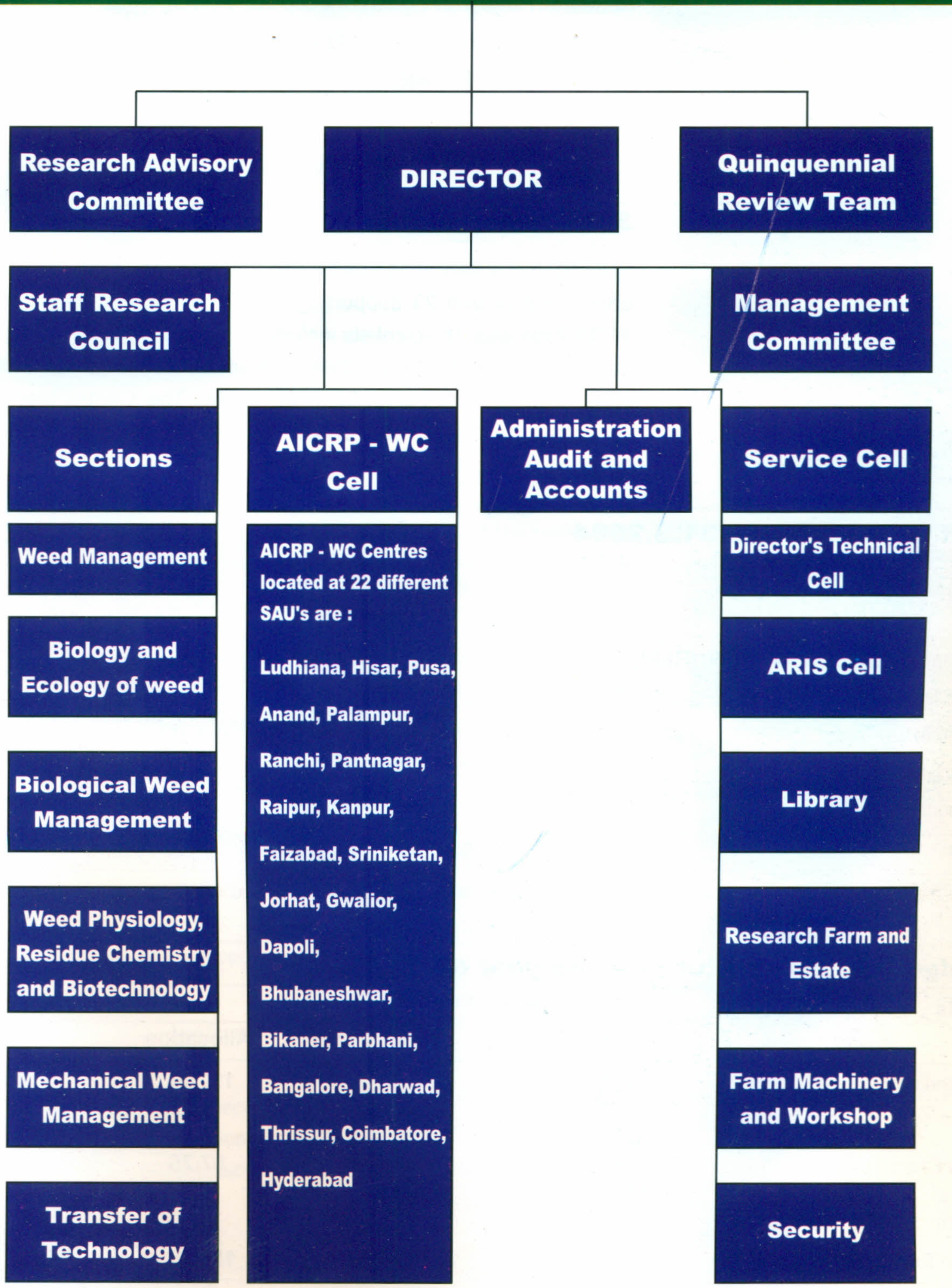
Library

At present the library is having a total collection of 1255 books. It has modern facilities such as CAB-PEST and CAB-SAC CD-ROMs and Current Contents on Diskette (CCOD) on biological sciences. The library subscribes to 65 Indian and 17 foreign journals. Reprographic and documentation facilities such as lamination and spiral binding machines are available for preparation of documents and reports.

Research farm

The Centre has a well developed 61.5 ha land with adequate farm machines and good facilities, irrigation systems both conventional and sprinkler and an automatic weather station. Three poly/net houses and a quarantine net house have been constructed to conduct pot culture experiments. The soil of the research farm is medium black (*Typic Haplustert*) and moderately alkaline.

ORGANOGRAM OF NRCWS



AICRP-Weed Control

NRCWS acts as the coordinating centre for the All India Coordinated Research Project on Weed control (AICRP-WC), which has 22 cooperating centres, located in various State Agricultural Universities to undertake applied research related to site-specific problems concerning weed management.

Staff and Finance

NRCWS has a sanctioned cadre strength of 27 scientists, 28 technical, 13 administrative and 23 supporting staff. The current staff position as on 31.03.2004 was 18 scientists including one post of RMP, 25 technical, 10 administrative and 23 supporting. The annual budget of the Centre for the year 2003-2004 is indicated in the table. The Centre also generates resources through the sale of farm produce and testing of new herbicide formulations provided by the industries.

Staff position as on 31.3.2004

Categories	Sanctioned	Filled	Vacant	Additional Sanctioned*
Research Management Position (RMP)	01	01	-	-
Scientific	26	17	09	-
Technical *	28	25	03	7
Administrative*	13	11	02	1
Supporting*	23	23	-	2
Total	**91**	**76**		**10**

* 10 posts under Technical, Administrative and Supporting Categories have been approved in the EFC meeting of the Centre held at the ICAR.

Budget and expenditure for the year of 2003 -04

(Rs. in lakhs)

Heads	Plan		Non-Plan	
	Allocation	Exp.	Allocation	Exp.
Pay and allowances	15.00	13.73	110.00	100.27
TA	3.00	2.49	1.20	0.45
HRD	0.50	0.61	-	-
Other Charges	97.50	83.34	67.75	67.72
Works	28.00	28.00	9.00	9.00
Others	1.00	-	-	-
Grand Total (A+B)	145.00	128.17	188.10	177.44
Pension			2.00	1.89
P-Loan			16.00	15.98

Weed management through genotypes and cultural practices

Weed competitive crop cultivars

Chickpea

Ten released and pre-release varieties of chickpea - JG1, JG7, JG11, JG15, JG16, JG18, JG63, JG130, JG322, JG218, JG322, JG315, JKG92337 were evaluated under unweeded, single hand weeded and weed free conditions. The field was mainly infested by *Cichorium intybus, Vicia sativa, Chenopodium album, Physalis minima, Euphorbia geniculata, Lathyrus aphaca, Rumex dentatus and Cynodon dactylon.* The varieties JG11 and JG315 were promising under single hand weeded condition in terms of both seed yield and weed competitive abilities. The variety JKG92337 despite having a better canopy coverage was not able to produce higher yield because of its susceptibility to frost.

Wheat

Eighteen wheat varieties were tested under weedy, single hand weeded and weed free conditions for their ability to suppress weeds. The weed flora in the experimental field were: *Vicia sativa, Medicago hispida, Lathyrus aphaca, Cichorium intybus, Chenopodium album, Physalis minima, Phalaris minor* and wild oats. The variety WH147 proved superior with higher yields under both unweeded and single hand weeded condition. In general, 3 varieties WH147, Raj 33765 and DL803-3 were promising with higher yields and weed competitive abilities. Most of the varieties tested produced near potential yields under single hand weeded condition.

Grain yield (t/ha) of different wheat varieties under varying weed management practices

Variety	Weedy	HW once	Weed free
HI 1077	6.93	7.33	7.44
PBW 343	6.51	7.27	8.89
UP2382	5.27	6.96	7.40
GW273	6.89	7.93	8.18
DL803-3	7.29	8.17	8.40
GW173	7.27	7.49	7.36
DL788-2	6.55	7.11	7.40
Lok-1	5.67	7.04	8.07
AKW-1	6.18	7.56	7.96
Raj3777	5.96	7.00	7.24
HD2285	7.07	7.67	7.24
HD2402	6.40	7.84	8.00
Raj3765	7.38	7.82	8.51
Sonalika	6.62	7.38	7.93
HD 8381 (Malva Shree)	5.33	5.78	7.36
HD8498 (Malwa Shakti)	5.04	7.04	7.56
Sujata	5.11	5.44	7.56
WH 147	7.49	8.22	5.67
Mean	6.38	7.29	8.87
LSD (P=0.05)	*W: 0.80*	*V: 0.87*	*W x V: NS*

In another experiment, the performance of wheat cultivars for their competitiveness against field bind weed (*Convolvulus arvensis*) (100-weeds/m^2) was studied. Results indicated that the variety HI 8498 significantly reduced the leaf area and dry matter production of field bind weed as compared to the variety C-306. However, the variety C-306 recorded the least reduction in yield due to field bindweed infestation (2.86%), which was closely followed by the variety HI 1077 (5%). The highest reduction in yield (22.4%) was recorded with the variety WH-147.

Evaluation of competitiveness of varieties of wheat against *Convolvulus arvensis*

Veriety	Leaf area of *Convolvulus* (cm^2/m^2)	Dry weight of *Convolvulus* (g/m^2)	Grain hield (g/m^2)		% Reduction
			yield infested	Weed free	
HI 8498	31.26	93.7	787.7	860.0	8.4
GW 273	68.60	133.3	775.0	890.0	12.9
HI 1077	44.30	111.7	760.0	800.0	5.0
Sonalika	39.60	136.7	620.0	690.0	10.1
Raj 3765	65.60	171.7	635.0	740.0	14.2
Wh 147	75.22	213.3	605.0	780.0	22.4
C-306	37.80	120.0	680.0	700.0	2.9
PBW 343	52.60	135.0	710.0	795.0	10.7
HD 2285	74.60	120.0	730.0	830.0	12.0
LSD (P=0.05)	-	*20.8*	*105.3*		

Upland rice

Forty eight upland rice genotypes were evaluated for their yield performance under single hand weeded condition. The results revealed that the varieties Dudharas (AC37081) (400g/m^2), RR2-6 (380g/m^2), Kalakeri (376.6 g/m^2), Gora (AC-37028) (376.6g/m^2) were promising. Among these varieties Dudharas (102.6 cm), Kalakeri (112.2cm) and Gora (111.0 cm) were of semi-tall type while RR2-6 (89.5cm) was semi-dwarf type.

Weed smothering intercrops

Integration of dhaincha green manuring for weed suppression in direct-seeded rainfed rice

Rice (sole) unweeded

Growing *dhaincha* (*Sesbania aculeata*) along with direct-seeded rice significantly reduced the weed population till 30 days after sowing (DAS). Pre-emergence application of butachlor 1.0 kg/ha followed by two hand weedings at 20 and 40 DAS produced the highest rice grain yield of 2.0 t/ha. Inclusion of *dhaincha* and killing it by 2,4-D 1.0 kg/ha at 30 DAS resulted in an increase in grain yield by 171% (1.056 t/ha) as compared to unweeded control (0.39 t/ha). This was also the most economical weed control treatment.

Weed growth, crop yield and economics as influenced by treatments in direct- seeded rice

Treatments	Weed count (no./m^2) at 60 DAS	Weed dry weight (g/m^2) at harvest	Grain yield (t/ha)	Additional return per rupee invested on weed control
Rice sole (unweeded)	19.9	11.2	0.39	-
Rice+butachlor 1.0 kg/ha+ 2 HW	6.1	4.1	2.00	1.95
Rice+butachlor 1.0 kg/ha + 1 HW+2,4-D 1.0 kg/ha	5.5	3.0	1.72	2.02
Rice+dhaincha + 2,4-D 1.0 kg/ha 30 DAS	13.5	9.9	1.06	2.83
Rice+ dhaincha + 2, 4-D 1.0 kg/ha 20 DAS + 1 HW	5.7	4.4	1.41	1.90
Rice+dhaincha+ butachlor 1.0 kg/ha + 2,4-D 1.0 kg/ha 30 DAS+1 HW	5.0	5.7	1.71	1.99
LSD (P=0.05)	*0.9*	*0.6*	*0.19*	-

** Subjected to square root transformation, HW Hand weeding*

Rice + Sesbania + 2, 4-D

Weed suppressing intercrops in mustard

The major weed flora observed were *Euphorbia geniculata, Avena ludoviciana, Medicago hispida, Physalis minima, Paspalum* sp. and *Vicia sativa*. Results indicated that all the three test intercrops (barley, oat and berseem) were effective in suppressing the weeds appearing in mustard crop. Highest mustard yield was obtained from mustard + berseem intercropping combination (1998 kg/ha) even as compared to mustard sole cropping (1803 kg/ha).

Mustard - berseem intercropping system

Effect of intercrops and weed control methods on weeds and yield of mustard and intercrops

Treatments	Weed count (no./m^2)*		Weed wt (g/m^2)*		Mustard seed yield (kg/ha)	Intercrop yield (kg/ha)
	60 DAS	Harvest	60 DAS	Harvest		
Mustard (M) sole	11.2	9.2	5.4	6.9	1803	
M+Barley	8.9	7.3	3.8	5.1	1561	1101
M+Oat	9.7	9.0	3.8	3.8	1672	19332[!]
M+Berseem	9.2	8.7	5.3	5.0	1998	4296[!]
LSD(P=0.05)	0.7	0.5	1.4	1.0	139	
Unweeded	10.6	8.7	5.8	6.7	1641	
1 HW	8.6	8.2	2.8	3.5	1887	
Pendim.1 kg	10.1	9.4	4.9	5.4	1749	
LSD(P=0.05)	*0.8*	*0.5*	*0.7*	*1.2*	*71*	

** Subjected to square root transformation,* *! Fresh fodder yield*

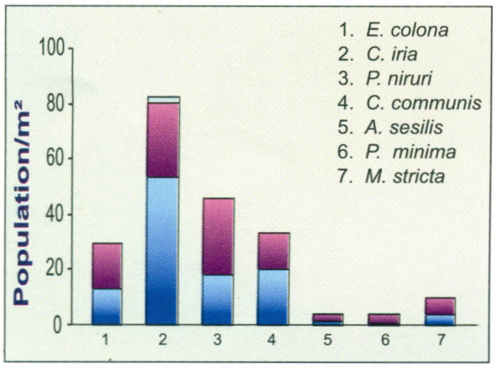
Soil solarization

Effect of soil solarization on weed dynamics in sesame

Non-solarised plot

Assessment of the effectiveness of soil solarization with and without FYM on the emergence of weed flora in sesame during *kharif* indicated that soil solarization for a period of 45 days with and without FYM checked completely emergence of *Echinochloa colona, Cyperus iria, Phyllanthus niruri, Commelina communis, Alternanthera sessilis, Physalis minima* and *Mollugo stricta.* Similar trend was also observed with total weed population and weed dry matter production. Soil solarization also significantly influenced the plant growth parameters of sesame. Significantly higher plant population per unit area, per plant leaf area, plant dry weight and plant height were recorded under soil solarizatrion with and without FYM as compared to non- solarization. Among weed control treatments, application of pendimethalin ether recommended or half of recommended dose significantly influenced the emergence of all weeds except *Commelina communis* and *Physalis minima.* Highest growth parameters of sesame *viz* per plant leaf area, plant height, plant population per meter row length and number of pods/plant and lowest weed growth *viz* population and its dry matter production were recorded with pre-emergence application of pendimethalin 1.25 kg/ha over weedy check.

Solarised plot



Weed population under solarised & non-solarised plots

Long term effect of soil solarization on weed and plant growth of sesame (Wet season, 2003)

Treatments	Weed population/m²	Weed dry weight (g/m²)	Plant population/ m²	Leaf area/ plant (cm²)	Plant height (cm)	No. of pods/ plant
Solarizationt						
Non-solarization (NS)	11.1	12.2	17.7	443	87.7	30.3
Soil solarization (SS)	0.8	0.7	23.3	576	92.1	33.1
SS +FYM	1.2	0.7	27.4	565	95.6	33.6
NS+FYM	10.8	11.1	17.6	372	89.1	27.8
LSD (P=0.05)	2.1	2.1	7.3	144	6.45	3.06
Weed control						
Weedy check	7.7	8.2	19.6	377	89.3	30.0
Pendimethalin (0.63 kg/ha)	6.0	4.6	20.5	516	92.5	30.5
Pendimethalin (1.25 kg/ha)	4.1	5.9	24.4	575	91.6	33.1
LSD (P=0.05)	***1.8***	***1.8***	***NS***	***124***	***5.58***	***2.91***

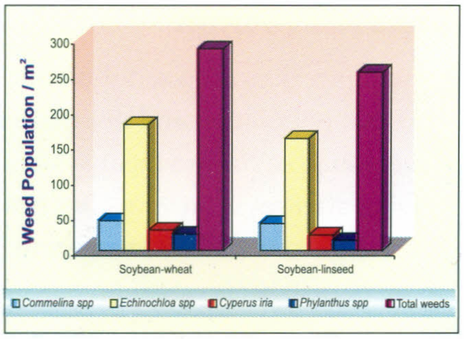
* *Subjected to square root transformation*

Tillage practices

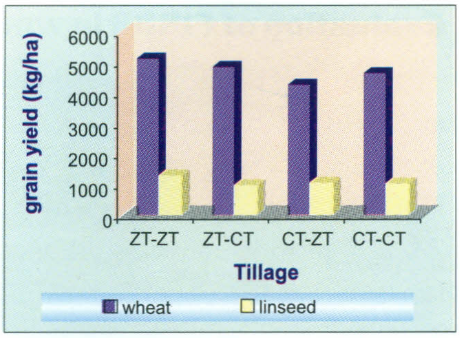
Influence of tillage on weed dynamics in soybean-based cropping systems

During the second year winter season, population of *M. hispida*, *V. sativa* was significantly higher in linseed than wheat. Zero tillage in both the seasons significantly reduced the weed infestation and resulted in higher yields of both wheat and linseed. In subsequent *kharif* season, irrespective of the species, weed population was significantly less in soybean-linseed than soybean-wheat systems. Zero tillage significantly reduced the population of *Phyllanthus* spp, but the population of *Commelina* spp. increased. Application of metribuzin 0.50-0.75 kg/ha gave broad spectrum weed control in soybean. Different cropping systems and tillage did not influence the seed yield of soybean significantly.

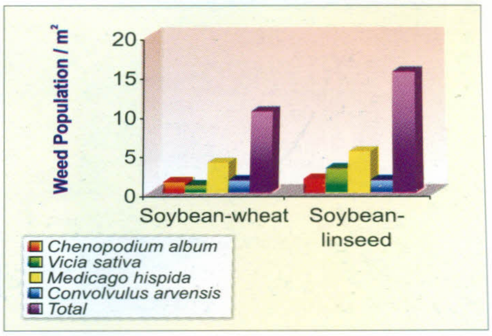
Soybean under zero-tillage



Weed population in soybean as influenced by cropping system



Effect of tillage on grain yield



Effect of cropping systems on weed dynamics

Influence of tillage on weed dynamics in transplanted rice-wheat cropping systems

Results of the second year field experiment on wheat indicated that zero tillage (ZT) planting reduced the infestation of *Phalaris minor*, *Medicago hispida* and *Chenopodium album*, but increased the problem of wild oat (*Avena sterillis* ssp. *ludoviciana*). Clodinafop at 60 g/ha fb 2,-4 D 500 g/ha effectively controlled both grassy and broadleaved weeds and provided higher grain yield of wheat.

Influence of tillage and weed control measures on grain yield (kg/ha) of wheat

Tillage	Weed control methods			Mean
	Weedy	Clodinafop	Isoproturon	
ZT (10 days advance sowing)	1088	4250	1629	2319
ZT (sowing at the time of CT)	906	2844	1250	1617
CT	1406	3163	1531	2033
Mean	1133	3419	1466	

LSD (P=0.05)-Tillage (A)-442; Weed Control (B) -311; AiBi-AiBj- 540; AiBi-AjBi-624

ZT Zero tillage; CT Conservation tillage

Effect of tillage and weed control measures on weed population and its dry matter in wheat						
Treatment	Weed population/m^2				Total weed population no/m^2	Total weed dry weight (g/m^2)
	P.minor.	*A. ludoviciana.*	*M.hispida.*	*C.album*		
ZT (ES)	2.3	19.2	2.8	1.1	412	233
ZT (NS)	8.0	15.0	5.7	1.4	357	258
CT	13.0	10.8	5.7	2.9	379	223
LSD (P=0.05)	***5.3***	***3.5***	***1.0***	***1.2***	***NS***	***NS***
Weedy	9.7	16.3	5.9	5.9	475	318
Clodinafop 60 g fb 2,4-D 500 g/ha	8.6	11.4	4.9	4.9	276	107
Isoproturon 1.0 kg/ha	4.7	17.2	3.4	3.4	397	289
LSD(P=0.05)	***2.0***	***2.7***	***3.00***	***3.00***	***103***	***63***

* Subjected to square root transformation
CT-Conventional Tillage; ZT-Zero Tillage; Early sowing; NS- Normal sowing

FIRBS machine

Wheat crop after soybean on raised weed

Evaluation of FIRBS in wheat-based systems

Effect of tillage and weed management practices on weed dynamics and yield in wheat-based system revealed that population and dry matter of weeds in wheat were lower in rice-wheat than soybean-wheat system. However, the grain yield of wheat was higher after soybean than after rice. ZT significantly reduced the weed dry weight in rice-wheat systems; however, it was at par to CT and FIRBS in soybean-wheat system.

Effect of cropping systems on weeds and grain yield of wheat							
Cropping system	Weed population/m^2 at 90 DAS					Weed dry weight (g/m^2)*	Grain yield (kg/ha)
	C. album	*M. hispida*	*V. sativa*	Others	Total		
Rice-wheat	4.5	2.4	1.2	1.4	5.9	5.0	4428
Soybean-wheat	5.0	3.9	1.3	1.4	7.2	6.1	5748

* *Subjected to square root transformation*

Effect of tillage and weed control methods on weeds in wheat under rice-wheat system						
Treatment	Weed population/m^2 at 90 DAS					Weed dry weight (g/m^2)
	C. album	*M. hispida*	*V. sativa*	Others	Total	
Tillage						
NT	2.3	2.4	0.8	1.6	4.0	4.00
CT	4.3	2.1	1.8	1.4	5.5	5.1
FIRBS	6.9	2.6	1.0	1.3	8.2	5.9
LSD (P=0.05)	1.2	NS	0.6	0.2	0.9	1.1
Weed Control						
Weedy	7.2	2.6	1.3	1.4	8.1	7.3
Herbicides	1.29	3.1	1.2	1.3	3.9	4.4
1 HW at 30 DAS	5.1	1.4	1.2	1.5	5.7	3.3
LSD(P=0.05)	***1.3***	***0.7***	***NS***	***NS***	***1.0***	***0.9***

* *Subjected to square root transformation*

Effect of tillage and weed control methods on weeds in wheat under soybean-wheat system						
Treatment	Weed population/m² at 90 DAS					Total weed dry weight (g/m²)
	C. album	*M. hispida*	*V. sativa*	Others	Total	
Tillage						
NT	3.3	4.9	2.0	1.2	6.5	6.6
CT	6.4	1.7	0.7	0.8	7.00	5.3
FIRBS	5.5	5.0	1.2	1.9	8.00	6.2
LSD (P=0.05)	1.4	0.9	0.4	0.6	NS	NS
Weed Control						
Weedy	10.6	6.9	1.5	1.5	13.5	9.3
Herbicides	0.7	3.2	1.1	1.4	3.5	4.2
1 HW at 30 DAS	3.8	1.6	1.1	1.0	4.4	4.9
LSD(P=0.05)	***1.5***	***0.6***	***0.6***	***0.2***	***1.8***	***1.4***

* *Subjected to square root transformation*

Performance of *rabi* crops under zero-till conditions

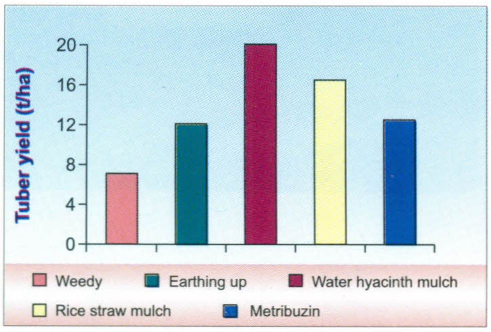
Keeping in view the successful cultivation of wheat after transplanted rice under zero tillage, six crops *viz.*, wheat (WH-147), chickpea (JG-315), pea (JP 885), linseed (JL 23-10), lentil (L 40-70) and mustard (Pusa Bold) were evaluated for their performance under ZT conditions. Results revealed that in almost all the cases weed biomass was either at par or less in ZT as compared to CT. Seed yields of various crops under ZT were also either at par or slightly higher than CT. This clearly indicated that not only wheat but other winter season crops could also be grown successfully under ZT conditions after transplanted rice.

Performance of rabi crops under zero-till conditions

Evaluation of winter crops under zero tillage conditions				
Crops	Weed biomass (g/m²)		Grain yield (kg/ha)	
	CT	ZT	CT	ZT
Wheat*	60	30	4800	4700
Chickpea	160	150	2400	2500
Pea	100	170	2500	2800
Lentil	240	170	1000	900
Mustard	70	65	1600	1700
Linseed	80	90	1600	1600

* Isoproturon 1.0 kg+2-4D 0.50 kg/ha was applied at 25 DAS

Water hyacinth mulching in potato



Effect of mulching on tuber yield of potato

Mulching

Effect of mulching on weed infestation in potato

The weedy plots were heavily infested with *Medicago hispida, Chenopodium album, Vicia sativa, Cichorium intybus* and *Physalis minima*. The mulched and metribuzin-treated plots were fully free of weeds. Compared to conventional method of earthing-up, rice straw and water hyacinth mulching increased tuber yield by 35 and 68%, respectively. The highest tuber yield of 17.5 t/ha was recorded in the water hyacinth mulch treatment followed by rice straw mulch (14.2 t/ha), metribuzin (10.8 t/ha), earthing- up (10.4 t/ha) and weedy (6.1 t/ha) treatments. Compared to earthing-up and mulch treatment, the percentage of total tuber yield discolored due to solar radiation was relatively more when metribuzin alone was used as a weed control measure. No additional benefit was recorded when metribuzin (PE) was applied along with mulch. It may be concluded that mulching with rice straw or water hyacinth biomass could eliminate weeding and conventional earthing-up operation besides significantly increasing tuber yield of potato.

Water hyacinth biomass as a source of green manure

Effect of dry water hyacinth mulching on spinach

Laboratory studies showed no allelopathic effect of water hyacinth decomposition products on germination of spinach and fenugreek seeds. In the incubation study it was noticed that available N, P and K content in the soil increased over control due to decomposition of water hyacinth biomass. In a field study, significant increase in the yield of these vegetable crops over control was recorded when water hyacinth was incorporated in soil. Water hyacinth green manure was inferior to urea but superior to FYM in terms of spinach yield, when N @ 120 kg/ha was applied through these sources Similar observation was recorded in case of fenugreek yield. It was concluded that water hyacinth biomass may be used to partially substitute the inorganic fertilizer N requirement of spinach and fenugreek.

Effect of different N sources on plant parameters of spinach

Treatments*	Plant height (cm) (g/m^2) (cm)	Fresh weight (g/m^2)	Dry weight (g/m^2)	Leaf Area (cm^2/plant)	Total chlorophyll (mg/g tissue)
Fresh water hyacinth	15.5	1285	100.9	62.4	0.77
Dry water hyacinth	13.3	987	79.6	58.8	0.90
Urea	21.7	1427	125.2	82.6	0.91
FYM	13.1	869	73.7	47.0	0.81
Control	13.4	693	57.2	46.0	0.79
LSD (P = 0.05)	***3.1***	***131***	***7.2***	***9.5***	***NS***

Weed management through herbicides

Transplanted rice

Halosulfuron methyl (NC319)

A new herbicide-halosulfuron methyl (NC319) was evaluated for its efficacy in transplanted rice (cv. *kranti*). The results showed halosulfuron methyl (NC319) at 60 g/ha applied at 6-9 days after transplanting (DAT) proved effective in weed control and produced higher yield in transplanted rice comparable to hand weeding.

Oxadiargyl

Bio-efficacy of the herbicide oxadiargyl 80%WP and 6% EC formulated from indigenous technical was tested in transplanted rice (cv. *kranti*). The results revealed that oxadiargyl formulation at 100 g/ha was effective for weed control and produced higher grain yield of transplanted rice. No difference was observed between the oxadiargyl formulations made from indigenous and imported technical.

Fenoxaprop-p-ethyl

Application of fenoxaprop at 56.25 g/ha (60 DAS) reduced the weed population and weed dry weight by 85 per cent. A higher dose to its normal though recorded lowest weed population but slightly phytotoxic effect was noted on the crop, which recovered later. It also produced the yield comparable to the weed free situation.

Efficacy of fenoxaprop in transplanted rice

Treatments	Weed population/m^{2}*	Weed dry weight g/m^{2}*	Weed control efficiency (%)	Grain yield (t/ha)
Fenoxaprop 45 g/ha	4.9	21.7	72.9	7.11
Fenoxaprop 56.25 g/ha	4.6	19.4	75.8	7.32
Fenoxaprop 112.5 g/ha	4.4	11.6	85.5	7.30
Weed free	0.7	-	100	7.85
Weedy check	5.3	80.3	-	6.39
L.S.D (P=0.05)	***0.6***	***3.3***	**-**	***NS***

**Subjected to square root transformation*

Direct seeded rice

Post-emergence herbicides

Application pretilachlor 750g/ha, fenoxaprop 70g/ha chlorimuron+metsulfuron 4 g/ha and pyrazosulfuron 25g/ha supplemented with one hand weeding gave moderate weed control and increased yield over weed check.

Fenoxaprop treated plot

Effect of post-emergence herbicides in direct seeded rice

Treatments	Weed count (no/m^2)	Weed dry weight (g/m^2)	Grain yield (Kg/ha)
Weedy check	9.4	53.6	1230
Weed free situation	0.7	-	3391
Fenoxaprop (70 g/ha)	7.8	27.4	1854
Chlorimuron+metsulfuron (4 g/ha)	8.2	31.2	1750
Pretilachlor(750 g/ha)+1HW	6.4	13.8	2790
Fenoxaprop+1HW/IC	6.1	12.3	2861
Chlorimuron+metsulfuron fb 1 HW	6.3	13.2	2788
Pyrazosulfuron (25 g/ha)+IC/HW	6.8	17.0	2432
LSD (P=0.05)	*0.7*	*2.6*	*289*

** Subjected to square root transformation*

Wheat

Sulfosulfuron 75 WG

Efficacy of sulfosulfuron was evaluated for its weed control efficiency against weeds in wheat. The experimental field was dominated mainly with grassy weeds (86 %). Sulfosulfuron at 100 g/ha significantly reduced the population of wild oat. Different levels of sulfosulfuron being at par with each other significantly reduced the total weed dry matter. The highest grain yield of wheat was recorded with sulfosulfuron 100 g/ha which was at par with lower dose (50 g/ha). Although sulfosulfuron inhibited the height, the higher yield was due to better control of weeds particularly wild oat.

Onion

Response of oxyfluorfen in onion

Lowest weed population and dry weight were observed under treatment pre-emergence application of oxyfluorfen 200 g/ha followed by one hand weeding at 30 DAT. This treatment also produced the highest onion bulb yield of 62.9 t/ha as compared to 23.1 t/ha recorded under unweeded condition. Pendimethalin 1.0 kg/ha as pre-emergence followed by one hand weeding at 30 DAT was the next best treatment.

Effects of herbicides and their integration with hand weeding on weeds and yield of onion

Treatments	Weeds/m^{2*} 50 DAT	Dry wt. of weed 50 DAT (g/m^2)*	Bulb yield (t/ha)
Oxadiargyl 90 g/ha 3 DAT	11.3	7.4	33.2
Oxyfluorfen 200 g/ha pre-em.	10.1	6.5	47.8
Pendimethalin 1.0 kg/ ha pre-em.	13.3	7.1	36.1
Metolachlor 1.0 kg/ ha pre-em.	11.7	6.9	45.2
Oxadiargyl 90 g/ha 3 DAT + 1 HW	8.3	6.4	45.1
Oxyfluorfen 200 g/ha pre-em. + 1HW	7.8	2.4	62.9
Pendimethalin 1.0 kg/ ha pre-m.+1HW	9.9	6.0	55.9
Metolachlor 1.0 kg/ha pre-em+1HW	11.7	7.2	50.1
Hand weeding (20 & 40 DAT)	8.0	4.1	42.2
Weedy	22.8	17.2	23.1
LSD(P=0.05)	*0.8*	*0.8*	*9.5*

** Subjected to square root transformation* DAT-days after transplanting

Carfentrazone-ethyl

Application of carfentrazone-ethyl (20-25 g/ha) at 35 DAS was found to decrease weed population and weed biomass. The grain yield was higher under carfentrazone-ethyl at 25 g/ha as compared to its lower dose. Application of carfentrazone-ethyl +isoproturon (Affinity) at 35 DAS also was found to decrease weed population and weed biomass at 2.0 kg/ha. The grain yield was the highest under weed free treatment followed by carfentrazone-ethyl + isoproturon at 2.0 kg/ha.

Effect of carfentrazone in wheat

Effect of Carfentrazone-ethyl and affinity on species wise weed count/m^2 in wheat

Treatments	Rate (kg/ha)	*Cheno-podium*	*Medi-cago*	*Lathyrus*	*Avena*	Weed dry weight (g/m^2)*	Yield (kg/ha)
Weedy check	-	24	38	11	85	-	3256
Weed free	-	-	-	-	-	73.4	1124
Carfentrazone-ethyl	15	19	27	6	78	41.9	2450
Carfentrazone-ethyl	20	13	24	8	71	35.5	2680
Carfentrazone-ethyl	25	9	23	7	83	33.5	2750
Affinity	1500	11	22	6	22	21.2	2930
Affinity	1750	9	18	5	16	18.3	3012
Affinity	2000	8	13	5	11	14.6	3085
LSD (P=0.05)						*6.48*	*213*

**Subjected to square root transformation*

Thus carfentrazone-ethyl + isoproturon could be effective for the control of broad-spectrum weeds to a greater extent. There was no phytotoxic effect of carfentrazone-ethyl + isoproturon in wheat. carfentrazone-ethyl can be a good substitute of 2,4-D and metsulfuron-methyl for the control of broad-leaved weeds to a greater extent.

Effect of Affinity in wheat

In another trial the herbicides viz. metsulfuron, metribuzin and isoproturon were tested alone and in combination with each other. It was revealed that application of isoproturon 500 g/ha in combination with metsulfuron 2 g/ha was quite effective for controlling broad spectrum weed flora in wheat crop.

Relative efficacy of herbicides with and with out surfactant

In wheat, the relative efficacy of clodinafop, fenoxaprop, sulfosulfuron and triasulfuron were tried alone and in combination with surfactant. The application of sulfosulfuron with surfactant was effective for controlling grassy and broad-leaved weeds in wheat. The application of triasulfuron with surfacatant also could increase the efficacy of the herbicide. But on the other hand surfactant could not contribute much in increasing the efficacy of fenoxaprop or clodinafop.

Effect of herbicides with and without surfactant in wheat

Treatments (g/ha)	Weed population/m²				Weed dry Weight (g/m²)	Yeild (kg/ha)
	Avena	*Cheno-podium*	*Medi-cago*	Others		
Clodinafop 60	3	18	20	7	18.1	2888
Fenoxaprop 100	5	16	17	5	20.7	2712
Sulfosulfuron 25	48	7	10	4	33.2	2655
Triasulfuron 20	90	2	3	3	40.1	2640
Clodinafop+S (60+0.5%)	2	17	18	6	16.5	2742
Fenoxaprop +S (100+0.5%)	16	13	17	6	26.0	2800
Sulfosulfuron +S (25+0.5%)	28	2	3	3	30.4	2690
Triasulfuron +S (20+0.5%)	86	2	3	3	38.0	2644
Weed free					-	3189
Weedy	112	20	18	12	73.5	1650
LSD (P=0.05)	-	-	-	-	*5.26*	*194*

Enhancing the efficacy of triasulfuron surfactant

Results of another set of experiment revealed that application of triasulfuron at 40 g/ha with surfactant was found very effective to control broad-leaved weeds in wheat. Highest weed control efficiency for broad-leaved weeds was observed under traisulfuron 40g/ha with surfactant (Hasten).

Efficacy of SYNA 8424 G (8%) for grasses

The new molecule pinoxaden was tested against grassy weeds in wheat. The compound SYNA A-8424 G (Clodinafop) at 100 g/ha respectively provided an excellent control of grasses which was at par with clodinafop. The surfactant hasten did not improve the efficacy of new molecules.

Bio- efficacy of herbicides against field bindweed (*Convolvulus arvensis*)

In order to find out effective post emergence herbicides against *Convolvulus arvensis* in wheat, 12 herbicides were evaluated. Results indicated that metsulfuron + dicamba (4+ 500 g/ha) was found to decrease the population and dry weight of field bind weed and other broad leaf weeds and was at par with metsulfuron (4g/ha + dicamba 500g/ha), carfentrazon (20 g/ha), 2,4-D (500 g/ha), sulfosulfuron (25 g/ha), trisulfuron (20 g/ha) and IPU + 2,4-D (1000 + 500 g/ha), respectively. Among different herbicides metsulfuron + dicamba (4+ 500 g/ha) resulted in the highest grain yield of wheat which was at par with carfentrazon 20 g/ha and metsulfuron + 2,4-D (4+ 500 g/ha). The highest weed biomass was registered with metribuzin (300 g/ha) and imazethapyr (100 g/ha).

Effect of herbicides on C. arvensis and yield of wheat

Treatments	Population of *Convolvulus*/m^2	Dry weight of *Convolvulus* (g/m^2)		Grain yield (g/m^2)
		at 60 DAS	at harvest	
Metribuzin 500 g/ha	5.7	46.9	82.5	347.1
Metsulfuron 4 g/ha	3.8	31.4	29.2	441.7
Dicamba 500 g/ha	3.8	20.3	28.3	412.5
2,4-D 750 g/ha	4.0	33.4	31.7	425.0
Carfentrazone 20 g/ha	3.7	26.4	30.8	510.4
Sulfosulfuron 25 g/ha	4.8	62.1	46.3	433.3
Trisulfuron 20 g/ha	4.5	49.3	35.0	379.2
Imazethapyr 100 g/ha	5.1	74.6	58.3	218.8
Metsulfuron 4g/ha +dicamba 500g/ha	2.4	14.6	17.5	487.5
Metsulfuron 4g/ha +2.4-D 500g/ha	3.5	26.6	30.0	449.2
Isoproturon 1000g/ha +dicamba 500g/ha	3.6	18.3	35.0	412.5
Isoproturon 1000g/ha +2,4-D 500g/ha	4.6	30.8	35.8	403.3
Weedy check	6.0	79.3	88.3	321.3
LSD (P=0.05)	***1.2***	***13.0***	***21.7***	***62.6***

Effective herbicides for alligator weed

Testing of herbicides alone or in combination revealed that atrazine, paraquat, Almix or combination of 2,4-D, glyphosate and metsulfuron methyl with each other or with paraquat did not control alligator weed satisfactorily. Three herbicides namely 2,4-D ethyl ester (2.0 - 2.5 kg/ha), glyphosate (2.5-3.0 kg/ha) and metsulfuron methyl (MSM) (16-20 g/ha) proved to be most effective to control alligator weed. Repeated application of herbicide in higher doses at 90 days after the first application was necessary for effective management due to heavy re-growth, which, started to appear even after 30 days of herbicide applications. Among these three herbicides, MSM was found most effective.

Residue studies showed that 2,4-D and glyphosate could not be detected from water at 45 and 60 days after application (DAA), respectively. However, MSM was detected at 60 DAA but at very low level.

Chemical control of alligator weed

Effect of herbicides on aquatic environment and insect bio-agents

Beetle attack on parthenium

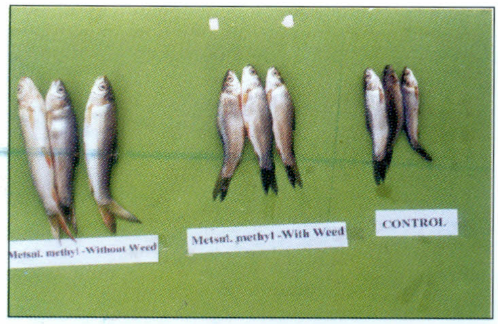
Mexican beetle

Of the recommended herbicides tested, 2,4-D caused about 20-40 % mortality of beetles followed by glyphosate and metribuzin. Freshly emerged beetles were found more susceptible than the old beetles.

Symptoms of damage due to Cassida sp.

Cassida sp

Impact evaluation studies of herbicides on *Cassida* sp. nr *enervis*, a bioagent on alligator weed proved metsulfuron-methyl as most effective and safe herbicide followed by glyphosate and 2,4-D. Glyphosate and 2,4-D caused significantly higher mortality of bioagent when applied topically on leaves. Both larval and adult stages were affected but the former was found more vulnerable than adult stage. The effect of 2,4-D was more pronounced than glyphosate and MSM on freshly emerged beetles than the old beetles. Test on egg mortality also revealed MSM to be the safest herbicide against bioagent followed by glyphosate and 2,4-D. This study suggested that in biological and chemical integration, use of MSM would be safe against bioagent.



Fish growth under metsulfuron application

Effect of herbicides on fish

Mortality of fishes was least due to direct effect of herbicides even at higher doses of 2,4-D (2.5 kg/ha), glyphosate (3.0 kg/ha) and MSM (0.024 kg/ha), when sprayed in water tanks having no weeds. However, significantly higher fish mortality occurred corresponding to increase in dose of 2,4-D, when applied on weed. Fish mortality was recorded to be 20,26 and 46% at 1.5, 2.0 and 2.5 kg/ha doses of 2,4-D, 13.30,16.60 and 23.30 at 2.0, 2.5 and 3.0 kg/ha doses of glyphosate, 6.60, 10 and 10 at 16 20 and 24 g/ha doses of MSM and at 60 DAA, respectively. In MSM-treated tank, no significant fish mortality was observed. Reduction in water quality due to lower dissolved oxygen content caused by decaying wed biomass might have been the primary cause for mortality of fish in 2,4,D and glyphosate-treated tanks. This study proved that MSM could be applied in fish-ponds for the management of alligator weed without fear of fish mortality.

Effect of herbicides on water quality

Herbicides influenced water quality parameters like pH, DO, and biological oxygen demand (BOD) after spray on the weed. pH decreased corresponding to increase in concentrations of all the herbicides used. All the herbicides significantly decreased pH over control at 0 and 1 DAA. The decrease in pH was least by MSM followed by glyphosate and 2,4-D.

Decrease in pH was less in water tanks having no weeds than the water tanks having weeds. However pH increased corresponding to increase in time but it varied from herbicide to herbicide

All the herbicides significantly decreased the Dissolved oxygen (DO) at '0' day except MSM when applied in the water tanks devoid of weed, with 2,4-D causing maximum reduction. DO also decreased with time in all the treatments including control. DO was least affected in tanks having no weeds. This confirms that decrease in DO was mainly due to the disintegration of weed owing to the action of herbicides.

Based on the effectiveness on alligator weed and minimum impact on bio-agent, fish and water quality, metsulfuron-methyl is recommended for chemical and integrated management of alligator weed @ 16 and 20 g/ha for aquatic and terrestrial form of alligator weed, respectively.

Spray application techniques for herbicides

Different application techniques of herbicides viz., high volume spraying, medium high volume, low and ultra low volume were evaluated for their weed control efficiency in soybean and wheat crops. The weed control efficiency attained in soybean has been found varying between 72.55 to 81.66 % (based on number/m^2) and 58.73 to 76.98 % (based on dry weight, g/m^2). Low weed control efficiency has been found in very low volume sprays as compared to other spray application techniques. The lowest weed control efficiency has been found in medium high volume sprays in wheat crop i.e. 64.75 and 75.28 % as compared to other treatments based on no/ m^2 and fresh weight respectively. The other treatments have shown almost similar weed control efficiency varying between 80.05 to 85.80 % (based on no/ m^2) and 81.02 to 87.50 % (based on fresh weight).

The seed yield of soybean has been found varying in close range i.e. 9.85 to 11.01 q / ha which indicated that there is not much influence of different spray application techniques. The grain yield of wheat crop has been found varying between 2.38 to 3.82 t / ha. The grain yield of wheat in different spray application treatment is varying closely between 2.70 t / ha to 3.28 t / ha showing that there is not much influence of different spray application methods.

Weed control efficiency and yield of soybean under spray application techniques

Treatment	Soybean		Wheat	
	WCE (%)	Yield (t / ha)	WCE (%)	Yield (t / ha)
High volume spray (450 l/ha).	73.8	1.08	80.8	3.17
Medium h igh volume spray (225 l/ha).	81.66	1.01	64.7	3.28
Low volume spray (50 l/ha)	76.7	1.07	80.0	2.71
Very low volume spray (20/ha).	72.6	1.01	84.4	2.83
No weed control treatment.	00.0	0.18	00.0	2.38
Weed free treatment.	100.0	1.10	85.8	3.82

Design and development of improved weeding tools

Trial of aquatic weed cutter in pond

Visit of RAC to the workshop

The engine powered aquatic weed cutter/harvester developed at the Centre was tested in pond and modifications/fabrication work has been carried out. A numbers of functional problems were experienced during its preliminary testing. The major observation made was the speed of forward movement of the developed unit was less then the required speed. For attaining the desired speed, two to three rotor fans of large size were added with some simplification in design of power transmission. But due to poor response of the rotor fans, blade type rotor was added to the unit. With this new arrangement the unit was tested in the month of Jan 04 and the unit was operated at satisfactory speed. In order to accommodate the blade type rotor, power transmission from engine to blade rotor was modified and fabricated. The power engaging and disengaging mechanism was also modified and fabricated to function effectively and efficiently. The testing work of the unit is on hand.

The Manufacturing drawings of improved weeding tools viz twin wheel hoe, big wheel hoe, multi-weeder, crescent hand hoe and NRCWS wick applicator were prepared along with part details so that these could be manufactured by industries and other organizations. The drawings made earlier were perfected and were sent to all AICRP-WC centers for their commercial manufacturing and extensive utilization of weeding tools. The prototypes fabricated in center's workshop were taken to farmers for their demonstration in *kharif* season. These weeders were used and demonstrated in farmers field in maize crop along with their comparison with herbicide/chemical control method in village Nunsar and Padaria.

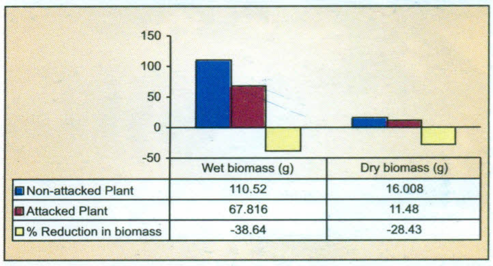
Weed Management through biological methods

Biological control of alligator weed

Turtle beetle *Cassida* sp. nr *enervis* was found to be a host-specific insect on alligator weed. Samples of alligator weed from aquatic and terrestrial forms were collected randomly during September 2001 to August 2003 from 5 prominent sites. The damage by the turtle beetle was noticed to be maximum during August and September months.

The beetle population was also found to be the highest during August to October.

A dry biomass reduction of about 28 per cent was noticed due to insect attack during September 2003 from naturally established population of alligator weed



Biomass (g) reduction in attacked plants over non-attacked plants

Augmentative measurement of bio-agent for control of *Parthenium*

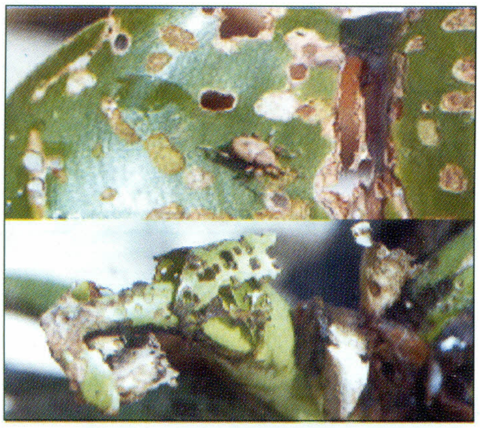
In net house conditions, augmentation of adult beetles @ 5,10,15, pairs/m^2 was found to result in 100% defoliation of *Parthenium* plants of 3.5 ft average height in 30, 25 and 22 days, respectively. In another experiment release of 4 beetle+ 25 larvae/m^2 (say as 4b+25 l) , 6b+50 l, 8b+75 l and 10 b+100 l/m2 resulted 100% defoliation of average 3.5 feet plant height in 60,40,30 and 22 days, respectively. In field conditions, early release of adult beetles showed varied effect, which was due to mobile phase of the insect. It was found that beetle released at one place, may exert effect at another place about 100 to 150/ m far from the released sites. However, at many places, release of adults at 2, 3 and 5 pairs/m^2 in mid July brought about complete defoliation by the 3^{rd,} 3r^{d} and 2nd week of August, respectively.

Damage potential of Mexican beetle on parthenium

Integrated management of *Parthenium*

Out of three tested herbicides (metribuzin, 2,4-D ethyl ester and glyphosate) in different concentrations, metribuzin at 0.3 % was found most effective to control the *Parthenium*. In naturally-infested *Parthenium* stand, metribuzin was sprayed on the June emerged *Parthenium* during mid July where beetle showed good control of *Parthenium* last year. At the time of spray, population of beetle was almost nil. Herbicides controlled *Parthenium* effectively but low germination of new flush occurred by first fortnight of August. The newly-emerged beetles from the same area readily attacked this new flush and *Parthenium* growth was nipped in the bud.

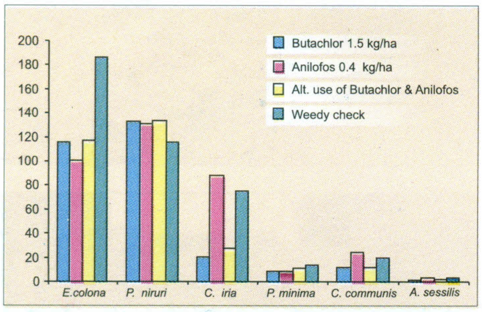
In another set of experiment, metribuzin was sprayed on June germinated flush in the mid-July in patches and larvae and adult beetles were released in the adjoining *Parthenium* stands. Population build-up caused defoliation of the *Parthenium* by the first fortnight of the August and also caused complete defoliation of newly germinated *Parthenium* where herbicide was sprayed. In the area where, bioagent was not released, *Parthenium* was defoliated by the end of September. This suggests that in large *Parthenium*-infested area, herbicide can be sprayed in patches and Mexican beetle can be released in the adjoining area. This integration will help to facilitate early control of *Parthenium* by the bioagent.



Weevil attack on water hyacinth

Integrated management of water hyacinth

About 1000 weevils of *Neochetina* spp. were released in the pond over an area of 3000 m^2 for further population build up of the bioagent on 31st May 2003. Herbicide spray in 15% area resulted in early control of water hyacinth. The adult and larvae of *Neochetina* spp. were recorded about 7 and 8 per plant, respectively. By the end of April 2004, one wave of control was achieved. This early collapse of the weed within a period of 11-12 month could be due to integration of herbicide with the bioagent, which would otherwise have taken minimum 24-48 months by the bioagent alone to control one cycle of water hyacinth.



Effect of herbicides on weed population (m^2)

Weed management in cropping systems

Rice-wheat

Weed flora shift under continuous use of herbicides in direct-seeded and transplanted rice- wheat cropping systems revealed that the highest population of *Echinochloa colona*, *Phyllanthus niruri*, *Physalis minima* and *Commelina communis* were recorded under direct-seeded rice (DSR)-wheat cropping system, whereas, *Cyperus iria* and *Alternanthera sessilis* were more under transplanted rice(TR) -wheat cropping system.

Continuous use of butachlor 1.5 kg/ha or alternate year use of butachlor 1.5 kg/ha and anilofos 0.4 kg/ha significantly reduced the emergence of *Cyperus iria*. However, all the herbicides reduced the emergence of *Echinochloa colona*, *Cyperus iria*, *Commelina communis* and *Alternanthera sessilis* as compared to weedy check. Highest weed population and weed dry matter production were recorded under direct-seeded rice-wheat cropping system. Among weed control treatments, butachlor 1.5 kg/ha or alternate year use of butachlor 1.5 kg/ha and anilofos 0.4 kg/ha reduced the weed population and weed dry matter production and gave significantly higher grain yield of transplanted rice. Direct-seeded rice failed to produce grain yield due to very heavy infestation of weeds.

Wheat-based systems

Studies on weed flora distribution under different cropping systems revealed that the infestation of *Medicago hispida* and *Vicia sativa* declined

Weed population and its dry matter as influenced by herbicides under rice -wheat systems			
Treatments	**Total weed count/ m^{2*}**	**Weed dry weight *(g/m^2)**	**Grain yield (kg/ha)**
Cropping system			
TR-Wheat	17.14	10.33	1495
DSR-Wheat	22.42	13.63	-
LSD (P=0.05)	***1.57***	***1.51***	
Herbicide			
Butachlor 1.5 kg/ha	18.10	11.00	1667
Anilofos 0.4 kg/ha	21.40	12.40	1575
Alt. use of butachlor & anilofos	18.05	11.18	1717
Weedy check	21.56	13.30	1021
LSD(P=0.05)	***2.22***	***2.14***	-

TR-Transplanted rice DSR Direct-seeded rice
* Values subjected to square root transformation

under soybean-wheat system as compared to direct-seeded rice-wheat cropping systems, whereas cropping systems did not affect weeds like *Avena ludoviciana, Phalaris minor* and *Cichorium intybus*. Significantly lowest weed dry weight was recorded under transplanted rice-wheat at 60 days after sowing and soybeanwheat-cropping system at harvest over direct-seeded rice- wheat system.

Among the weed control treatments, lowest population of *Avena ludoviciana* was recorded under clodinafop 60 g/ha, whereas that of *Medicago hispida* was recorded under continuous application of metribuzin

Effect of herbicides and wheat-based cropping systems on weeds and grain yield of wheat				
Treatments	**Weed count/m^{2*}**	**Weed dry weight (g/m^2)***		**Grain yield (kg/ha)**
		60 DAS	**Harvest**	
Cropping systems				
Soybean-wheat	12.52	13.84	14.96	2763
DSR-wheat	12.95	14.30	16.98	2466
TR-wheat	11.28	11.27	15.61	2428
LSD (P=0.05)	***NS***	***2.19***	***1.98***	***NS***
Herbicides				
Isoproturon 1.0 kg/ha	10.59	11.25	15.65	2285
Metribuzin 0.3 kg/ha	11.16	14.57	15.62	2023
Alt. use of clodinafop 60 g/ha & sulfosulfuron 25 g/ha	10.37	8.50	12.15	4517
Weedy check	16.90	18.24	20.00	1384
LSD (P=0.05)	***2.77***	***2.53***	***2.29***	***639.0***

* Values subjected to square root transformation

0.3 kg/ha. All the herbicides being at par with each other significantly reduced the weed population as compared to weedy check. Alternate year use of clodinafop 60 g/ha and sulfosulfuron 25g/ha significantly reduced the weed dry matter production at both 60 DAS and harvest and produced highest grain yield of wheat.

Nutrient management and weed control

Burning of crop residues

Crop residues left after harvest

Effect of wheat residue management on weeds in transplanted rice

The dominant weed flora found in transplanted rice was *Echinochloa colona, Cyperus iris, Alternanthera sessilis* and *Commelina communis*. Among wheat residue management, practices burning resulted significantly lowest weed population than removal and incorporation. Butachlor at 1.5 kg/ha reduced the population of *Cyperus iria*. Increasing levels of added nitrogen to the transplanted rice enhanced the population of *E. colona*. Application of 180 kg N/ha produced highest grain and dry matter yield of transplanted rice.

Treatments	*E. colona* (no/m^2)*	*C. iria** (no/m^2)	Total population (no/m^2)*	Total weed dry wt. (g/m^2) *	Grain yield (kg/ha)
Residue management					
Removal	4.7	3.7	12.3	5.7	4964
Burning	4.3	3.2	10.8	5.4	5111
Incorporation	4.7	4.3	13.4	5.67	4664
LSD (P=0.05)	***NS***	***NS***	***1.2***	***NS***	***NS***
Weed control					
Weedy	4.5	4.6	12.8	5.8	4804
Butachlor 1.5 kg/ha	4.7	2.8	11.5	5.4	5022
LSD (P=0.05)	NS	1.2	0.6	NS	NS
N levels					
N 60	3.8	3.0	12.1	5.5	4417
N 120	4.9	3.9	11.7	5.3	4947
N 180	4.9	4.3	12.7	5.9	5375
LSD (P=0.05)	***0.8***	***NS***	***NS***	***NS***	***759***

*Values subjected to square root transformation

Chemical weed control and nutrient availability

The contents of organic carbon, available P, S and K in the field soil that received chemical weed control measures for 5 years did not significantly differ from those recorded in the weedy plots of rice-based cropping system experiment. It was concluded that continuous application of herbicides, *viz*, butachlor, isoproturon and pendimethalin, at recommended levels did not cause any adverse effect on availability of nutrients in soil.

Crop-weed competition

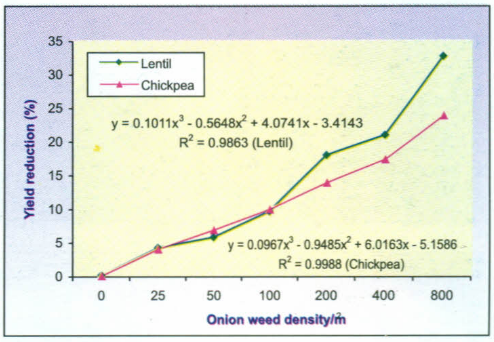
Field bind weed (*Convolvulus arvensis*) in wheat

A progressive decline in leaf area of both crop and weed, tillers per meter row length, panicle length and grain yield of wheat with increasing density of field bind weed from 20 to 280 weeds/m^2 over weed free treatment was observed. The yield losses ranged from 7% (20- weeds /m^2) to 35% under highest weed infestation (280- weeds/m^2). The yield levels under the treatment of 20 and 40 weeds/m^2 were comparable to that of weed free treatment indicating that 20 to 40 weeds/m^2 is considered to be the threshold levels for this weed, beyond which control measures are needed.

Effect of Convolvulus on wheat

Wild onion (*Asphodelus tenuifolius*) in chickpea and lentil

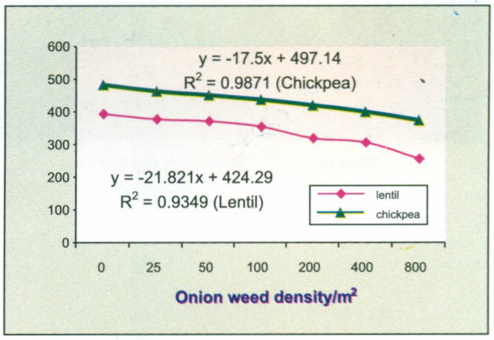
Increasing densities of wild-onion from 25 to 800/m^2 progressively increased its seed production capacity (g/m^2). Seed production capacity was more in lentil than in chickpea. At a density of 100-weeds/m^2 yield reduction in both lentil and chickpea were almost the same. Further increase in weed density resulted in higher yield reduction in lentil than chickpea. Seed yield of both the crops decreased linearly with increase in weed density.



Yield reduction (%) in chickpea and lentil under varying density of weed onion

Wild onion (*Asphodelus tenuifolius*) in rabi crops

Different crops significantly affected the growth and yield attributes of wild onion. There was no single wild onion weed plant at harvest in pea. Wheat (*cv.* Sujata) was the other competitive crop in reducing seed production capacity of this weed. Frenchbean was the least competitive. There was 42.18 % reduction in pod yield of frenchbean due to this weed where as mustard and wheat yields were not affected due to this weed. Because of the severe frost during crop season, frenchbean crop was badly affected and hence green pod yield was taken.



Effect of varying density of onion weed on seed yield of chickpea and lentil

Growth and reproduction of wild onion as influenced by different winter crops

Crop	Plant height (cm)	Leaves/ Plant (no.)	Dry weight (g/plant)	Inflorescences/ Plant	Fruits/ Plant	Seeds/ Plant	Seed weight (g/plant)
Wheat	30.4	5.2	0.8	1.1	2.9	7.8	0.0
Chickpea	42.2	10.0	1.4	1.9	20.3	48.8	0.1
Pea*	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mustard	35.2	6.9	0.6	1.5	14.3	58.7	0.1
Lentil	43.8	11.3	1.5	2.0	38.8	81.1	0.3
Linseed	35.7	9.2	0.4	1.5	14.1	81.7	0.2
Frenchbean	44.2	12.7	1.5	2.6	54.9	103.4	0.3
Wild onion	50.1	17.2	2.5	1.4	67.4	208.8	0.8
LSD (P=0.05)	*10.8*	*1.9*	*0.3*	*0.4*	*9.4*	*23*	*0.1*

Pea (cv. JP 885) completely suppressed the wild onion

Effect of onion weed on growth and yield of different winter crops

Crops	Leaf Area Index	Light interception (%)	Crop yield (kg/ha) Weedy	Crop yield (kg/ha) Weed free	Reduction in crop yield (%)
Wheat	-	-	-	-	0.6
Chickpea	-	-	2986	3695	19.2
Pea	6.48	95.9	2736	2886	5.2
Mustard	3.68	93.5	3555	3556	0.0
Lentil	2.13	58.1	1861	2250	17.3
Linseed	1.22	55.9	2167	2361	8.2
French bean*	3.02	47.2	3564	6134	42.2
LSD (P=0.05)	*0.35*	*17.0*	-		-

* Green pod yield

The rice varieties with better weed competitive ability

Jungle rice (*Echinochloa colona*) in upland rice

Jungle rice is an important grassy weed causing significant damage in upland rice ecology. Rice genotypes with different plant stature differ in their competitive abilities with *E. colona*. Three upland rice varieties - Vandana, Kalinga III (both semi-tall types) and Annada (semidwarf type) were subjected to differential weed pressure (0 to 80 *Echinochloa*/m^2.). The results indicated that the yield reduction due to *E.colona* densities ranging from 5 to 80/m^2 ranged from 14.9% to 47.5% in case of Vandana and 20.0% to 55% in case of Kalinga III and 24.8% to 76.5% in case of Annada. It was also observed that at harvest time the plant height of rice was 10% and 15.1% higher than the weed in case of the semi-tall varieties Vandana and KalingaIII respectively while the weed height was 32.4% higher than rice height in case of the semidwarf variety Annada indicating that the former two varieties.

Effect of E. colona on its dry weight and grain yield of rice under different upland rice varieties

Variety/Density	0		5		10		20		40		80	
(No/m^2)	D	Y	D	Y	D	Y	D	Y	D	Y	D	Y
Vandana	-	343	46	292	80	253	151	213	250	200	350	180
Kalinga III	-	430	133	344	180	275	273	237	343	200	433	193
Annada	-	426	160	321	200	210	337	163	450	173	497	100
Mean	-	400	113	319	153	246	254	204	378	191	427	158

D- Dry weight of *E.colona* (g/m^2) Y- Grain yield of rice(g/m^2)

Rice flat sedge (*Cyperus iria*) in upland rice

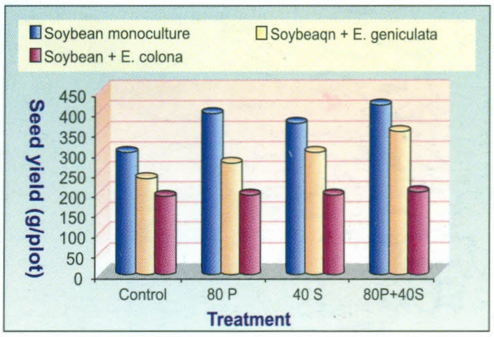
Three upland rice varieties Annada (semi-dwarf), Vandana (semi-tall) and Heera (dwarf) were grown under different densities (0, 10, 25, 50, 100 and 200 /m^2) of the weed. The results revealed that yield losses due to competition from *Cyperus iria* at densities of 10 to 200 plants/m^2 were lower in semi-tall variety Vandana (4.8 % to 20%) while they were higher in short statured varieties Heera (6.7 % to 40%) and Annada (5.6% to 36.5%). It was also observed that the rice plant height was lower than the weed height by 33.8% in case of Annada and 28.9% in case of Heera while the rice height was higher by 14.6% than the weed in case of Vandana variety.

Wetland amaranth (*Alternanthera sessilis*) in upland rice

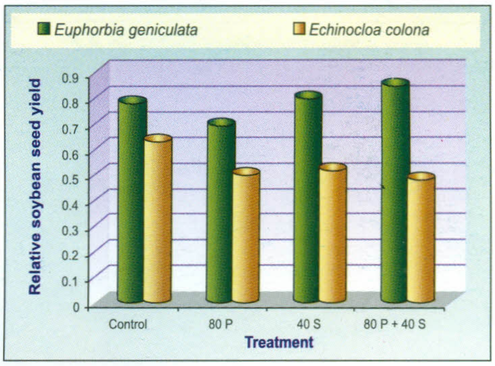
Increasing densities of *Alternanthera sessilis* from 0.5 to 8 plants/m^2 caused a grain yield reduction of upland rice to the tune of 29.6 to 89.5% indicating the severity of this problem.

Effect of phosphorus and sulphur supply on competition between soybean and weeds

Field experiments in microplots to study the effects of phosphorus (P) and sulphur (S) supply on interspecific competition between soybean (*Glycine max*) and two weed species (*Euphorbia geniculata* and *Echinocloa colona*) revealed that application of phosphorus and sulphur increased the leaf area and plant height of soybean and weeds. Among the two weeds, *E. colona* maintained higher leaf area and plant height as compared to *E. geniculata* during the crop growth period. Soybean in monoculture has maintained highest leaf area as compared to mixtures.



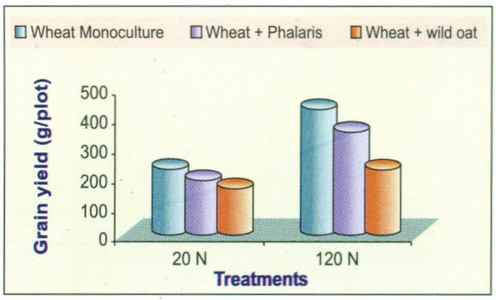
Application of 80 kg P_2O_5/ha + 40 kg S/ha increased the seed yield of soybean as compared to control. The reduction in seed yield was higher with *E. colona* as compared to *E. geniculata*.

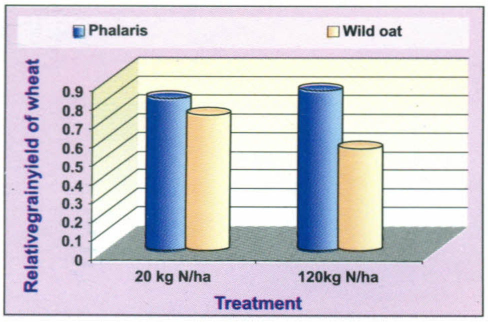


The relative seed yield of soybean was <1 in both the experiments, indicating that for this species the effects of interspecific competition were greater than the effects of intraspecific competition. It also shows that *E. Colona* was more competitive than *E. geniculata* as *E. Colona* recorded lower relative seed yield of soybean. The results are in conformity with those obtained in the last year. Therefore, it is concluded that between the two weed species *E. colona* was more competitive with soybean as compared to *E. geniculata*.

Effect of nitrogen on competition between wheat and weeds

The plant height and leaf area of both wheat as well as weeds increased with the application of 120 kg N/ha as compared to that of 20 kg N/ha. The height of *P. minor* was lower than that of both wheat and *A. ludoviciana* upto 60 DAS while at 90 DAS it has crossed the height of wheat while that of *A. ludoviciana* was initially lower than that of wheat but with time it has crossed that of wheat. The leaf area of wheat in mixture with *A. ludoviciana* was lower than that in *P. minor*. The leaf area of wheat was initially higher than that of both weeds but at later stages *A. ludoviciana* crossed that of wheat as well as *P. minor*.

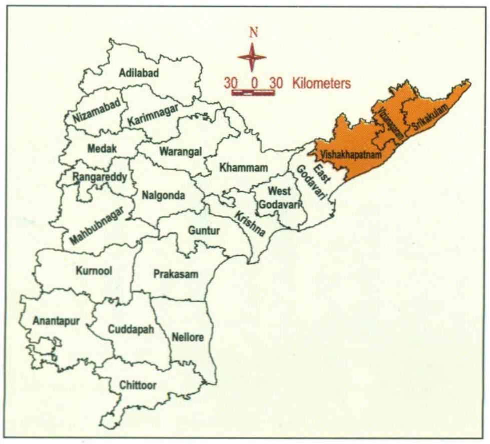




Grain yield of wheat increased significantly with the application of 120 kg N/ha over 20 kg N/ha. Competition due to wild oat resulted in greater yield reduction of wheat as compared to *P. minor*. The relative grain yield of wheat was <1 in both the experiments, indicating interspecific competition for these species. The present study revealed that between the two weed species wild oat was more competitive with wheat as compared to *P. minor*.

Biology and eco-physiology of weeds

A new weed problem in rice fallow pulses



Area infested with Vicia sativa in A.P.

A survey was conducted to study a problem weed in the rice fallow pulses reported by the farmers of north coastal Andhra Pradesh. The weed has been identified as *Vicia sativa.* Based on the information collected from different sources it is estimated that this weed has infested an area of about 7200 ha in three north coastal districts of A.P namely Srikakulam, Vizianagaram and Visakhapatnam. According to the farmers and officials of Department of Agriculture this weed has been reported for the first time during late 80s but has become severe from 1995-96 onwards. The infestation is higher in transplanted rice fallows than direct-seeded rice fallows and this weed is spreading very quickly through irrigation water, sheep penning and also by the use of the pulse seed from the crops, which are affected by this weed. The yield losses range from 50-100% and the crop produce is also fetching lower price due to contamination by the weed seeds.

Studies on depth of emergence of *kharif* weeds

The depth of emergence of seven major *kharif* species under non-cropped situation viz. *Echinochloa colona, Corchorus acutangulus, Cyperus rotundus, Parthenium hysterphorus, Euphobia geniculata, Physalis minima* and *Altananathera sessilis* was recorded during July, 2003. Highest depth of emergence was recorded in *C. rotundus* (3.2 cm). Depth of emergence of broad leaved weed species *P. hysterophous* (1.2 cm), *E. geniculata* (1.7 cm), *P. minima* (1.5 cm) and *A. sessilis* (1.1 cm) were higher than that of grass (*E. colona* with 0.3 cm).

Seed production potential

Maximum number of seeds of *Lathyrus aphaca* (404/plant) and seed weight (6.0g/plant) was recorded under zero tillage with application of paraquat under weedy situation. In case of minimum tillage, application of isoproturon recorded significantly similar number of seeds (316.3/plant and seed weight (4.7 g/plant). In case of *Avena ludoviciana* highest number of seeds (73. 1/plant) was observed under zero tillage with weedy situation. However, higher seed weight (4.9/plant) was recorded under minimum tillage with application of isoproturon.

Weed seed bank studies

Weed seed bank studies under long-term herbicide trial in rice-wheat rotation revealed that highest number of *Echinochloa colona* seeds (58.3/ kg soil) was recorded from 5-10 cm soil depth during August under isoprutoron 1.0 kg and butachlor 1.5 kg/ha and minimum (6.0/kg soil) was observed under clodinafop 80 g/ha followed by 2,4-D 0.5 kg/ha and butachlor 1.5 kg/ha. Minimum number of *Commelina cummunis* seeds (0.83/kg soil) was recorded under sulfosulfuron 25 g/ha and butachlor 1.5 kg/ha at 5-10 cm depth. The highest emergence of *Phalaris minor* (12.5 /kg soil) was observed at 0-5 cm soil depth during the month the November under control treatment. However, under clodinafop 80 g/ha followed by 2,4-D 0.5 kg/ha and butachlor 1.5 kg/ha and the same herbicides applied in wheat and anilophos 0.40 kg/ha in rice showed no emergence of *P. minor* during the same month. Maximum number of *Medicago denticulata* (7.5 /kg soil) emerged under control from 0-5 cm soil depth. The emergence of *E. colona* continued upto October but *C. cummunis* emerged during August only. *Caesulia auxillaris* emerged during October only and highest number (0.9 /kg soil) was observed under sulfosulfuron 25 g/ha and butachoor 1.5 kg/ha and isoprutoron 1.0 g/ha and anilophos 0.4 kg/ha.

Effect of herbicides on biochemical changes of *Cyperus rotundus*

The chlorophyll a, b and total content decreases due to application of ammonium glufosinate (0.75 kg/ha) and it showed a decreasing trend from 24 hours after application of the herbicides The carbohydrate content decreased from 24 hours after application of ammonium glufosinate (0.75 kg/ha) followed by glyphosate (2.0 kg/ha) both at normal temperature and at 27^0 C. Protein content also decreased significantly with gradual increase in time The effect of herbicides in reducing the protein content of *C. rotundus* was in order of ammonium glufosinate > glyphosate > glyphosate + ammonium sulphate. Under normal light the protein content was found to be minimum (0.64 mg/g) after 168 hours of application of ammonium gluphosinate. *Cyperus rotundas* grown in acidic soil showed significantly higher polyphenol content (2.67 mg/g tissues) over neutral soil.

Weed seed dormancy

Ageing of weed seeds in a liquid preservative

The seeds including those of the weeds e.g., *Parthenium hysterophorus, Cassia sericea, Phalaris minor, Echinochloa glabrascence, Echinochloa crus-galli, Medicago denticulata* and *Rumex dentatus* continue to show germination in yearly viability assessment test. The germination of the seeds of 1992-93 lots was 89±2.5% in *Parthenium hysterophorus*, 77±2.0% in *Cassia sericea*, 52±2.6% in *Phalaris minor*, 88±3.0% in *Echinochloa glabrascence*, 93±1.0% in *Medicago denticulata*, 92±3.0% in *Echinochloa crusgalli*, and 83±1.5% in *Rumex dentatus*.

Germination of parthenium seeds

Parthenium seeds were collected at monthly intervals from the surrounding area of the NRCWS and tested for germination in the dark and subsequently under illuminated outdoors conditions. The results obtained so far show that the seeds collected in the summer months have poor germination, and hence seem to be dormant.

Germination of *Phalaris minor* seeds

The seeds germinated well at 18°C, followed by at 10°C and at 28°C, successively. There was no germination at 40°C. The germination was very slow but near total at 10°C, and the seedling growth was drastically reduced at this temperature. Though a fewer seeds germinated at 28°C, the seedling growth was not affected.

The seeds germinated over a wide range of pH at 18°C. Germination took place at 2-13 pH. There was some reduction in germination and seedling growth at the extreme pH 2 and 13.

The seeds showed marked reduction in germination at ψ_{ω}-0.50 MPa. A few seeds germinated at -0.75 MPa. The seedling growth was drastically reduced. There was no germination at -1.0 HPa.

The germination of seeds was not affected upto 0.10 M NaCl salinity. Beyond this salinity level it declined gradually. The reduction in germination was more than 50% at and above 0.20 M NaCl. At 0.26 M NaCl the germination was reduced to about 10%. The seedling growth showed marked reduction at higher levels of salinity (0.20-0.26 M NaCl).

The germination appeared very sensitive to submergence in water. There was a marked decline in germination in 4-11 days submergence in water. Submergence in water for 14 days resulted in loss of germinability in almost all seeds. However, dehydrogenase activity in the seeds after submergence for 46 days was about 30 times the value showed by non-submerged but soaked for 24 hours seeds.

Phenolics in the seed soak water of the seeds subjected to germination at different temperatures for 1, 2, and 3 days and sampled before radicle emergence did not show a marked trend with time. Biochemical analyses of the seeds sampled after 1, 2, and 3 days after initiation of the imbibition but before radicle emergence showed decrease in sugars with time at all temperatures. This was more prominent at 10, 18, and 28 °C. Amino acids and phenolics did not show a marked trend. The buffer soluble protein did not show any trend. The dehydrogenase activity increased with time at 18°C. It was more than two fold. There were five and ten fold increases in á-amylase in the seeds 2 and 3 days respectively, after initiation of imbibition.

The germination and seedling growth of the weed were excellent at 18°C. It was slow but complete with lower seedling growth at 10°C, and was very low at 28°C though the seedling growth was not affected. The seeds germinated at wide range of pH, salinity and water stresses and showed moderate response to the stresses comparable to the common wheat.

In the present study the seeds lost germinability with submergence for 4-6 days and entered secondary dormancy by 11 days submergence. Incidentally the seeds showed very high levels of dehydrogenase activity (about thirty times) in response to anaerobic stress derived secondary dormancy after 46 days of submergence.

Seeds were allowed to germinate at different temperatures and those, which had not shown radicle emergence, were sampled daily for three days and subjected to the biochemical analyses. There was not significant difference in the release of phenolics out of the imbibing seeds into the imbibition medium. Also, there was no marked difference in the levels of phenolics in the seeds with time. Thus, the phenolics are unlikely to play a role in the germination at different temperatures. The decrease in sugars in the seeds with time might be due to their use by the seeds in the germination processes. This was more obvious in the seeds at 10, 18, and 28 °C. This corresponds to germination in the seeds. There appears to be very high levels of metabolic activity in the seeds at 18°C, the temperature at which all seeds germinated and the seedling growth was vigorous. This was obvious from the increase in dehydrogenase activity with time at 18°C. It was more than two times higher after three days. There was five and ten fold increase in á-amylase in the seeds 2 and 3 days respectively, after initiation of imbibition at 18°C. Thus, the species appears to have adapted for carrying out metabolic activities at 18°C to facilitate germination and seedling growth. The á-amylase is synthesized *de novo*. The increase in the enzyme could be taken as an index of protein synthesis and of state of metabolic activity of the seeds. Similarly, enhanced dehydrogenase activity also evidences this.

The findings of the study implicate that the weed i). has moderate stress tolerance during seed germination, ii). seeds germinate well at 18°C, followed by at 10 and 28°C, and fail to germinate at 40°C; iii). seeds are very sensitive to submergence in water as they lose germinability in about 14 days; and iv). seeds are adapted physiologically to germination and grow at low temperatures, and the metabolic activities necessary for germination appear to be optimum at about 18°C, than at above and below this temperature.

Allelopathy

Allelopathic effect of previous crop and weed (wheat and *Phalaris minor*) on rice

Decomposing and decomposed aqueous leachates of wheat and *P. minor* residue (mature straw collected at harvest) in 0-10 percent concentrations were used to study their effect on germination and growth of rice *in vitro*.

Effect of wheat residue: Wheat residue had no significant adverse effect on the germination of rice but in 10 %w/v concentration significantly inhibited root and shoot length of rice. The decomposed leachates showed stronger adverse effect than the decomposing ones. These effects were also exhibited in the soil medium, which proved that the allelochemicals present in the wheat residue were active in adversely affecting the growth of the rice grown after wheat.

Effect of Phalaris minor residue : The residue of *Phalaris* had no significant adverse effect on the germination of rice. The root and shoot growth were adversely affected at 5 and 10% concentrations. These effects were also found to persist in the soil and significantly inhibited the root and shoot growth of rice.

Studies on the allelopathic potential of growing *E. colona* plants on rice

Rice and *E. colona* plants growing in the field in monoculture with standard agronomic practices were collected at regular intervals (at 20, 30, 40 and 60 DAS), dried in the oven at 65 ^{0}C for 72h, powdered and leachates obtained by overnight soaking in distilled water and their effect on the germination and growth of rice and *E. colona* were studied in petridish bioassay. The leachates of 20 days old plant of *E. colona* had no effect on germination of rice but significantly inhibited root and shoot growth in higher concentrations. The effects of 10% leachates also persisted in soil. Leachates from 30 and 40 days plants were toxic to germination and root and shoot growth. The root growth was completely inhibited with 10% leachates of 60 days old *E. colona* plant. Shoot growth was also severely affected. Although these toxic effects of leachates on root and shoot growth of rice were reduced to a great extent in the soil, the adverse effects persisted were found to be significant.

Mutual allepolpathic influences between rice and *E. colona*

Rice and *E. colona* plants were grown in the field with different densities of 26, 50,100, 200 and 400 plants/m^2 in mono and mixed culture (1:1) and various observations on height, dry weight and yield parameters were taken at 20, 30, 40 and 60 DAS.

In mixed culture of 100 plants/m ^{2}, it was observed that the height of rice and *E. colona* were adversely affected as compared to their respective heights in monocultures at 20 DAS and subsequently, there was no adverse effect. The effect on dry weight of the crop in mixed culture was inhibitory at 20 and 40 DAS. The dry weight of *E.colona* was adversely affected in mixed culture at 20 DAS but became stimulatory thereafter.

When the density of crop and weed were increased in mono and mixed culture, the effect on height was not linear as expected. There was increase in height of the crop and weed in mono and mixed culture with increasing plant densities. Similar results were also obtained in the case of plant dry weight up to 200 plants / m2, but at density of 400 plants/m^2, there wars significant reduction of plant dry weight in mono and mixed culture of crop and weed. It may then mean that in case of the rice variety 'Vandana', neither the crop nor the weed had any adverse effect (mutual negative allelopathy) on each other.

With yield parameters (panicle length, grains per panicle, grain test weight and total grain yield), it was revealed that there were significant reductions in all of them in mixed culture as compared to their respective monocultures (3.6g/ panicle and 240g / m^2 in mixed culture as compared to 6.46g / panicle and 350g / m^2 in monoculture respectively). There was also linearity in decrease in crop yield with increase in weed density.

Management of allelopathic influences on rice

The rice crop is subjected to different types of allelopathic influences like, the effect of residue of the previous crop and weed (wheat and *P. minor*) and the mutual allelopathic influences of the growing crop and its associated weeds. It was expected that various agricultural practices like summer tillage, solarization, summer moong and dhaincha green manuring might have positive effects on the management of the negative allelopathic effects on the growth of rice. It was noted that all these practices improved the crop growth in mixed culture as compared to the respective control. The best crop growth in mixed culture was noted with soil solarization (45 days during May-June), followed by dhaincha incorporation (grown for 45 days and incorporated), summer moong (grown for 45 days and incorporated) and summer tillage was at par.

Allelopathic effect of previous crop and weed (rice and *E. colona*) on rice

The effect of leachates obtained from the residue of rice and *E. colona* were studied on the germination of wheat and its problem weed *Phalaris minor* in petridish culture experiments. Similar experiments were also repeated last year. It was observed that the leachates of rice and *E.colona* residue had no effect on the germination of wheat and *Phalaris minor* but the root and shoot growth of rice was severely affected in higher concentrations of rice and *E.colona* leachates, the effect of latter being more severe. The experiment was also conducted in pots by incorporation of the residue in soil and it was observed that *E. colona* residue showed more adverse effect on wheat growth than rice and mixed residue in monoculture of wheat. In mixed culture of wheat and *P. minor*, the effect of rice residue on wheat was more severe. The effect of mixed residue in mixed culture on wheat was more severe than the corresponding monoculture corroborating the double components of allelopathy i.e. mutual allelopathy due to crop-weed interaction and allelopathy due to the residue of previous crop and weed.

Evaluation of allelopathic potential of *P. minor* on wheat

It was observed that root growth of wheat was the most sensitive parameter in this bioassay test. The results revealed that 10% of the *P. minor* leachates from all stages of growth (20, 30, 40, 60 and 80 DAS) and 5% leachates of 30 days old plant completely inhibited the growth of wheat. The decomposed leachates of *P. minor* on wheat germination and seedling growth showed a similar trend like that of the decomposing leachates but is slightly less severe. Often 1% leachates of 80 days old plant stimulated root growth.

Evaluation of mutual allelopathic effect of wheat and *Phalaris minor*

In field experiments, where wheat and *P. minor* were grown in mono and mixed culture with plant density of 100 plants / m^2 and uniform fertilization, it was found out that in monoculture, the height of wheat was slightly more than *P. minor* from 20 DAS on wards up to 80 DAS and only during the flowering period the height of *P. minor* was greater than rice. The dry weight of wheat, all along, was higher than *P. minor* i.e. the DW of wheat was 6.08, 8.08, 3.25, 2.47 and 3.37 times more than the DW of *P. minor* at 30, 40, 60, 80 and 125 DAS respectively. In mixed culture however, the dry weights of wheat was 10.5, 5.78, 1.74, 2.55 and 4.46 time that of the dry weight of *P. minor* at 30, 40, 60, 80 and 125 DAS respectively. It was therefore apparent that there was significant reduction of dry weight of wheat at 40 and 60 DAS when grown in mixed culture with *P. minor* and should be considered to be due to the severe allelopathic effect of the latter on the crop. In another field experiment when wheat and *P. minor* were grown in different densities of 100:0.0, 50:50, 44:66 and 25:75 it was observed that the maximum plant height and dry weight of wheat was recorded in its monoculture, which were decreased with increasing weed population. In the case of *P. minor*, it was observed that its height was not affected with increasing the population but the dry weight accumulation was adversely affected at later stages of growth.

Estimation of terpenoid contents of wheat and *P. minor*

The results revealed that in growing plants of wheat, there was a gradual increase in polar terpenoids content with increasing age and the highest amount of non polar terpenoids fraction was noted with plants of 30 and 40 days old. In case of *P. minor* the highest amount of polar and non-polar terpenoids were noted with plants of 60 and DAS. Wheat contained more amounts of polar and non-polar terpenoids than *P. minor*.

Allelopathic effects of eco-friendly weeds on *Parthenium*

The leachates obtained from the root, of *Physalis minima* and leaf leachates of Amaranthus spinosus were found to be highly toxic and showed strong inhibitory effect on the germination, root and shoot growth of *Parthenium*.The chlorophyll and protein content in the *Parthenium* leaf were also significantly reduced. It was apparent that both the species have significant negative allelopathic effect on *Parthenium* and may help in allelopathic suppression of it when grown together.

Effect of herbicides on *Azolla pinnata*

Three herbicides - butachlor, pretilachlor and analiphos in standard doses i.e. 2 kg/ha, 0.75 kg/ha, 0.4 kg/ha, were evaluated for their toxic effect on *Azolla.* Anilofos was found to be relatively less toxic to both the components of the symbionts. It was therefore concluded that Anilofos at 0.4 kg/ha as pre-emergence herbicide in rice is good and can be used where *Azolla* is to be released as the sole or partial source of organic nitrogen.

Herbicidal activity of plants and their constituents

Phytotoxicity of phenolic allelochemicals to aquatic weeds

Phytotoxicity of quinol on *Chara* sp., *Apomogeton minor*, *Ceratophyllum demersum* and *Hydrilla verticillata* was studied outdoors in 20 liter water to find precise lethal concentration of the allelochemical for the submerged aquatic weeds. The treatments were repeated three times. The experimental results show wide variation in the lethal concentrations of the allelochemical to submerged weeds outdoors. The lethal concentration of the allelochemical appears to depend on several factors and precise experimental conditions. This reflects that precision in the lethal concentration outdoors may not be accorded unless experimental conditions are controlled precisely. The results of the experiments conducted in 20 litre volume in tubs and those obtained from the experiments undertaken in smaller volumes in plastic containers were different. It is suggested that potentially phytotoxic allelochemicals from smaller test medium may be repeated in larger test volumes for more reliable results.

The quinol was lethal to rice (*Oryza sativa* var. Kranti) at and above 5 mM. The allelochemical was, thus, found to be lethal to the crop at a concentration much higher than the lethal concentration to *Chara* sp. There might be such selective toxicity in case of other allelochemicals and this may form basis of probable use of allelochemicals for the weed management. Phytotoxicity of quinol on submerged weeds *Chara* sp., *Apomogeton minor*, *Ceratophyllum demersum*, and *Hydrilla verticillata* outdoors in 20 liter test volumes

Treatment (mM)	% Change in biomass over original value 12 days after initiation of the treatment in *Chara* sp.	*Apomogeton minor*	*Ceratophyllum demersum*	*Hydrilla verticillata*
Control	19.311.2	21.06.5	21.87.8	17.66.5
0.01	-27.312.4	-8.65.5	3.95.2	24.331.5
0.05	-46.46.3	-22.116.8	-100.0	-10.44.7
0.075	-100.0	-100.0	-100.0	-10.26.3
0.10	-100.0	-100.0	-100.0	-11.916.5
0.50	-100.0	-100.0	-100.0	-100.0
1.00	-100.0	-100.0	-100.0	-100.0

Values are means of three replications SD.

Phytotoxicity of parthenium residue on wheat

The weed residue at 3.3-13.3 t (dry)/ha did not affect crop and major weed emergence and contrary resulted in better crop growth and yield. The effect of the weed residue on crop under fertilized conditions was not much pronounced. The results of the experiments repeated three times including the present trial conclusively suggest that parthenium may not inhibit wheat through allelopathy under field conditions. This is so as the production of biomass out of a luxuriant stand of the weed may be around 3.3-6.6 t ha^{-1}, and even if entire biomass is felled at once in the soil, which is unlikely, the allelochemic load added to the soil would not be able to show allelopathy. Nor does the weed residue seem to be capable of inhibiting major weeds of wheat i.e., *Phalaris minor*, *Avena* sp., *Chenopodium album*, *Medicago denticulate*, and *Parthenium hysterophorus*.

Effect of parthenium plant residue (PR) on wheat var. WH 147

Treatment	Weed incidence (/m²)		Yield (t/ha)	
	Number	Biomass (dry) in g	Grain	Straw
Control	58163	38.09.3	2.150.09	4.240.13
*RFD	573142	33.710.9	4.390.11	6.060.03
PR at 3.33 t/ha	46912	29.311.3	2.420.10	3.980.08
PR at 6.66 t/ha	46957	30.78.7	2.790.09	3.590.17
PR at 9.99 t/ha	55887	30.13.5	3.260.06	3.950.08
PR at 13.3 t/ha	461128	42.213.0	4.050.08	5.200.46
LSD (P=0.05)	NS	NS	0.17	0.41

*Recommended dose of fertilizers (RFD) ; PR- *Parthenium* residue

Effect of parthenium plant residue (PR) on wheat var. WH 147 under fertilized conditions (RFD)

Treatment	Weed incidence (/m²)		Yield (t/ha)	
	Number	Biomass (dry) in g	Grain	Straw
RFD weedy	451114	39.15.9	5.450.11	8.730.10
RFD hand weeded	-	-	6.730.07	9.770.16
RFD + PR at 3.33 t ha^{-1}	34771	31.119.7	6.240.07	9.951.62
RFD + PR at 6.66 t ha^{-1}	26139	24.89.0	6.530.13	8.080.70
RFD + PR at 9.99 t ha^{-1}	25212	23.66.9	6.720.11	8.890.82
RFD + PR at 13.3 t ha^{-1}	21746	24.41.3	7.050.13	9.810.41
LSD (P=0.05)	109	NS	0.22	NS

Phytotoxicity of parthenium residue on french bean

The experimental results of the present trial and those of earlier years conclusively showed that the PR improved growth of the crop at higher levels of the treatments. The PR was not phytotoxic to the crop and hence allelopathic inhibition of the crop by parthenium is ruled out.

Effect of parthenium plant residue (PR) on french bean var. contender

Treatment	Weed incidence (/m²)		Yield (t/ha)	
	Number	Biomass (dry) in g	Grain	Straw
Control	31761	15.23.5	0.940.06	1.460.15
*RFD	37593	31.516.9	2.020.08	3.170.15
PR at 3.33 t ha^{-1}	25576	15.24.6	1.120.09	2.050.47
PR at 6.66 t ha^{-1}	27935	18.65.4	1.340.08	2.070.02
PR at 9.99 t ha^{-1}	275113	22.43.7	1.640.10	2.610.54
PR at 13.3 t ha^{-1}	28888	26.79.1	1.900.10	3.680.10
LSD (P=0.05)	NS	NS	0.13	0.47

*Recommended dose of fertilizers (RFD). ; PR- Parthenium residue

Phytotoxicity of *Lantana camara* L. on wheat var. WH 147

The results of the present experiment and those of earlier year showed that weed residue at 3.3-13.3 t (dry)/ ha was inhibitory to the crop growth and yield. The results suggest that the weed may inhibit wheat through allelopathy under field conditions when its residue is at sufficient levels. The inhibition is less pronounced under well-fertilized conditions. This is so as the production of leaf biomass out of a luxuriant stand of the weed may be around 3 t/ha, and if the residue accumulates subsequently and is incorporated into the soil, may inhibit the crop.

Phytotoxicity of lantana leaf residue on french bean

The experimental results of the present experiment and those of earlier year showed conclusively that the lantana leaf residue reduced crop yield especially at higher levels. Thus, under certain conditions accumulation of lantana leaf residue in the soil may inhibit the crop and also allelopathic inhibition of the crop by lantana is possible in a natural agro-ecosystem.

Effect of lantana leaf residue (LR) on French bean var. Contende

Treatment	Weed incidence (/m²)		Yield (t/ha)	
	Number	Biomass (dry) in g	Grain	Straw
Control	51655	32.85.5	0.940.07	2.350.35
*RFD	42596	27.414.2	1.940.06	3.000.36
LR at 3.33 t/ha	336116	22.74.3	0.720.08	2.120.15
LR at 6.66 t/ha	433116	26.26.2	0.620.07	2.280.10
LR at 9.99 t/ha	39734	27.48.3	0.530.08	2.140.16
LR at 13.3 t/ha	23980	15.97.2	0.430.06	1.360.10
LSD (P=0.05)	NS	NS	0.14	0.56

*Recommended dose of fertilizers (RFD).

Herbicidal activity of neem on alligator weed

The neem (*Azadirachta indica* A. Juss.) leaf residue at lethal concentration affected enzymes of oxidative stress in the leaves of alligator weed (*Alternanthera philoxeroides* (Martius) Grisebach). There was initial spurt in activity of some of the enzymes. However, subsequently it declined rapidly.

Phytotoxicity of neem on aquatic weeds

Different parts of neem had different phytotoxicity to various aquatic weeds. In general leaf residue, fruit pulp residue, green fruit residue, and seed residue had remarkable phytotoxicity on the tested aquatic weeds.

Phytotoxicity of neem plant parts on aquatic weeds

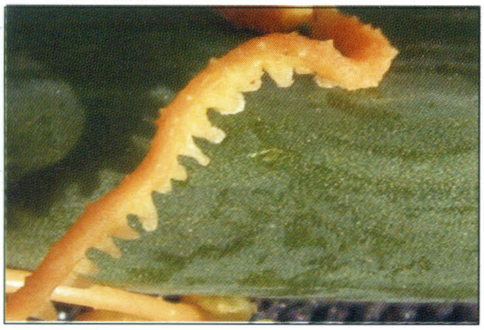
Plant part	Lethal concentration (%, w/v) for the weed									
	Eichhornia crassipes	*Pistia stratiotes*	*Salvinia molesta*	*Lemna pausicostata*	*Azolla pinnata*	*Spirodella polyrhiza*	*Najas graminea*	*Ceratophylum demersum*	*Hydrill verticillata*	*Chara sp*
Leaf residue	0.5	0.5	0.5	0.75	0.25	1.0	0.5	0.25	0.75	ND
Petiole residue	1.0	2.0	0.5	-	0.5	2.0	0.25	0.25	0.25	ND
Stem residue	-	-	-	ND	ND	ND	-	-	-	ND
Stem bark residue	1.0	2.0	2.0	1.0	0.75	1.0	0.5	0.5	0.5	ND
Root residue	2.0	2.0	2.0	2.0	0.5	2.0	1.0	2.0	1.0	ND
Green fruit residue	0.5	0.25	0.25	0.75	0.25	0.75	0.10	0.10	0.10	ND
Mature fruit pulp residue	0.75	0.75	ND	1.0	0.5	1.0	0.25	0.25	0.25	ND
Defatted seed residue	0.25	0.25	ND	2.0	0.25	2.0	0.25	0.25	0.25	ND

ND, Not determined; -, not lethal up to 2%.

Isolation of pentacyclic triterpenoid from *Lantana camara* and evaluation of its phytotoxicity on *Lemna pausicostata*

Another pentacyclic triterpenoid (other than lantadene A) isolated from the lantana leaves was partially purified using TLC and the compound was tested for phytotoxicity by *Lemna pausicostata* bioassay. The compound was not lethal to the test weed upto 50 ppm.

Management of problem weeds

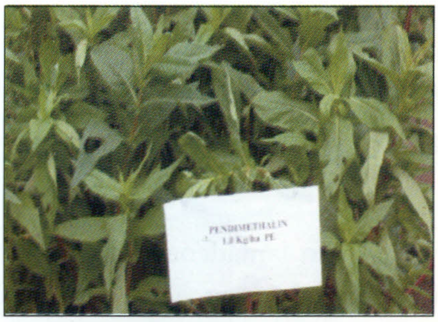


Integrated management of *Cuscuta* spp. in different field crops

Experiments revealed that fresh seeds of *Cuscuta* did not germinate. Concentrated sulfuric acid treatment for a period of atleast 30 minutes enhanced its germination upto 60-70 %. Maximum germination of *Cuscuta* was recorded from the surface. There was no germination beyond 8 cm seeding depth. During winter season, chickpea and lentil were the most susceptible crops followed by linseed and pea, whereas wheat, mustard and *rajmash* were not affected. Pendimethalin at 1.0 kg/ha as pre-emergence was found safe and effective against *Cuscuta* in niger, chickpea, linseed and lentil. Even a single plant of *Cuscuta* /m^2 caused significant yield loss in niger, greengram and lentil. Linseed variety Garima, JLS-27 and R-17 were comparatively tolerant to *Cuscuta* than other cultivars. The *Cuscuta* seeds could not germinate under less than 16 % soil moisture in upper 5 cm soil. The study of host-parasite relationship during *kharif* season revealed that greengram was the most susceptible (90 % loss) followed by niger (80 %) and sesame (72 %), whereas rice and cowpea were not affected. Pendimethalin at 1.0 kg/ha as pre-emergence was found effective against *Cuscuta* and increased yields to an extent of 80.3 % in blackgram, 565 % in niger and 216 % in linseed as compared with *Cuscuta*-infested plots. *Cuscuta* could survive without host up to 8 days during rainy season. Niger sown after 8 days of *Cuscuta* emergence was almost free from its infestation.

Flowers of *cuscuta*

Cuscuta infested



Pendimethalin 1.0 kg

Cuscuta free

Effect of pendimethalin on Cuscuta in niger

Effect of *Cuscuta* on lentil and chickpea

Micro-plot (1m^2) field experiments showed a progressive decrease in yield of both the crops with increasing densities of *Cuscuta*. The loss in yield due to *Cuscuta* density from 1 to 10/m^2 ranged from 49.1 to 84.0 % in case of lentil and 54.7 to 98.7% in case of chickpea. *Cuscuta* seed yield ranged from 36.7 to 80.0 g/m^2 in case of chickpea and 54.2 to 86.2 g/m^2 in case of lentil with increasing density from 1 to 10/m^2.

Effect of Cuscuta on lentil and chickpea

Cuscuta density (no/m^2)	Seed yield (g/m^2)		Loss in yield (%) over no *Cuscuta*		*Cuscuta* seed production (g/m^2)		No. of *Cuscuta* seeds (estimated) in 000's/m^2	
	Lentil	Chickpea	Lentil	Chickpea	Lentil	Chickpea	Lentil	Chickpea
0	177	368.3	-	-	-	-	-	-
1	90	166	49.1	54.7	54.2	36.7	47.5	32.2
2	80	102	54.7	72.4	56.2	40.0	49.3	35.1
3	77	88	56.4	76.0	60.1	45.0	52.8	39.5
4	760	70	56.6	81.0	62.1	50.0	54.5	43.9
5	70	50	60.4	86.4	64.1	53.0	56.2	46.5
6	68	27	61.5	92.7	70.1	58.0	61.5	50.9
7	58	20	67.2	94.6	73.1	60.0	64.1	52.6
8	50	15	71.7	96.1	75.2	65.0	65.9	57.0
9	48	6	72.7	98.3	78.2	70.0	68.6	61.4
10	28	4.6	84.0	98.7	86.2	80.0	75.6	70.2
LSD (P=0.05)	*24.1*	*23.5*			*8.9*	*23.5*		

Varietal reaction of chickpea to *Cuscuta* infestation

Ten chickpea varieties viz., JG1, JG7, JG11, JG15, JG16, JG18, JG63, JG130, JG322, JG218, JG322, JG315, JKG92337 were grown under *Cuscuta*-infested and *Cuscuta*-free conditions. None of the varieties exhibited any tolerance to *Cuscuta* infestation. The loss in yield due to *Cuscuta* ranged from 91.2 to 99.8 % in different varieties.

First report of an alien invasive weed in Jabalpur

Chromolaena odorata (L) R.M. King and H. Robinson (Synonym *Eupatorium odoratum*), is a perennial scrambling shrub of Neotropical origin. It was first deliberately introduced to India as an ornamental into the Royal Botanic Gardens in Calcutta in 1845. It is rapidly invading the rubber, teak, coffee, coconut, cocoa, cashew and other forest plantations and grazing lands along the western ghats in Karnataka, Tamil Nadu and Kerala. It is also a common weed in Assam, Orissa and West Bengal. The weed has recently been spotted for the first time in Jabalpur. The NRCWS has taken immediate action in creating awareness amongst officers of agriculture and through press release, distribution of handouts etc.

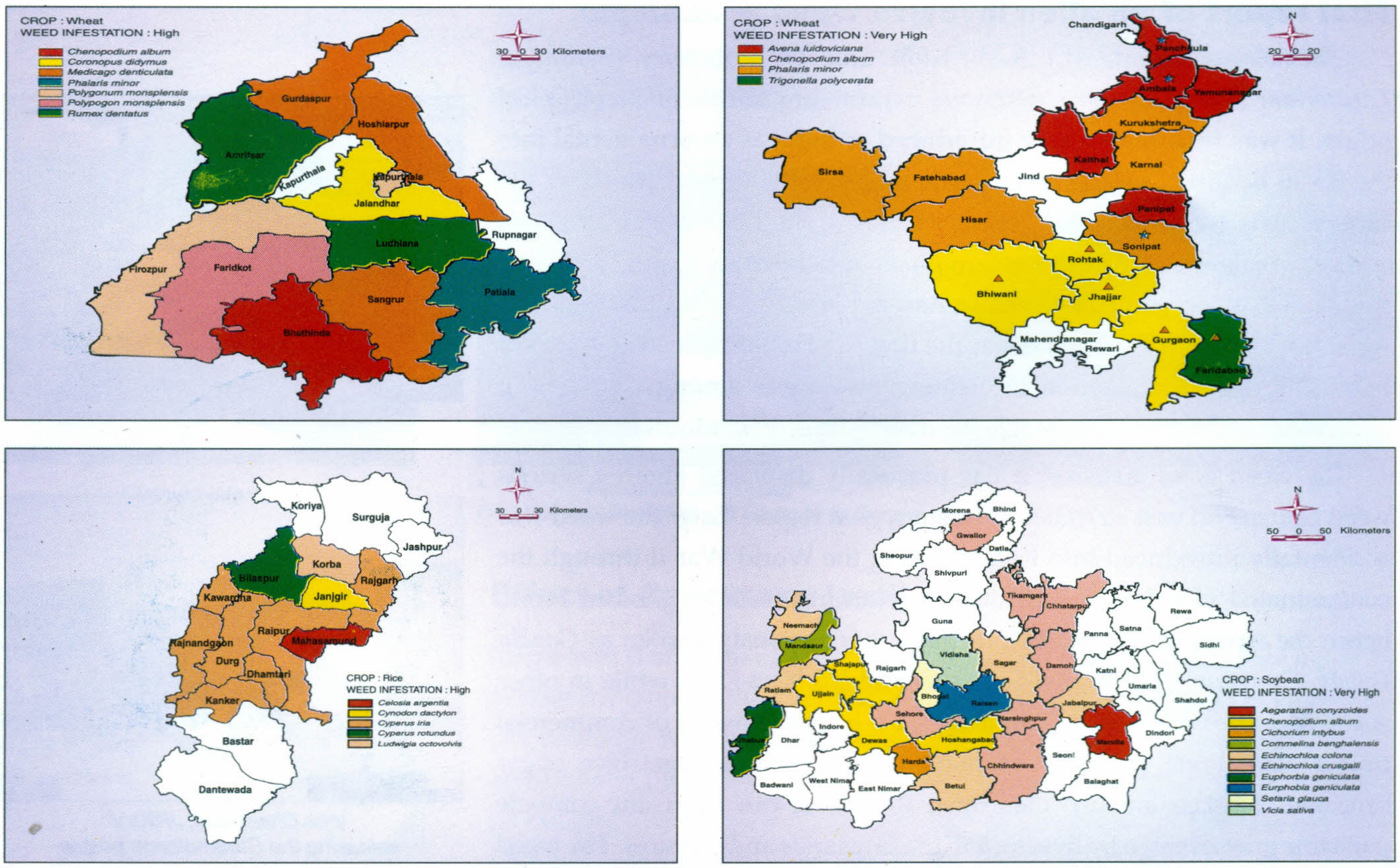
The weed is so invasive, it has practically displaced another serious weed *Lantana* on vast stretches in western ghat region. Later the weed was accidentally introduced into Kerala during the World War II through the contaminated clothing of the soldiers returning from the Assam Front, hence the name "*Assam patcha*". In India it is variously known as *Gandhi Gulabi*, *Communist pacha*, *Sam-Solokh*, *Tongal-lati*, *Sam-Rhabi* while in other Asian countries it is called *Siam weed*. It is a serious weed of commercial timber plantations, perennial plantation crops such as vegetables, sugar cane and tobacco and invades open forests. It can even out compete palatable grasses eaten by livestock in grazing lands and pastures. The weed constitutes a potential fire hazard particularly during the dry seasons.

Vice Chancellor, JNKVV releasing the Chromolaena poster

National database on weeds and weed herbarium collection

The information on major and minor weeds of different crops of 435 districts of the country has been documented in the database. These include the crops/cropping systems, growing situations and seasons. The diversity of different weeds in cropped and non-crop situations has also been depicted in database software. A number of useful queries have been designed to understand five major weeds of different crops of each district, distribution of a particular weed in each district and their degree of infestation in crops under varied situations. The other features of software are vernacular names of different weeds, viewing/querying weeds maps of different district and status of distribution of invasive weeds in the country.

Weed distribution maps of 435 districts of the country with dominating weed species have been programmed by using software (Arcview, 3.1). Altogether weed maps of 19 states viz. Assam, Andhra Pradesh, Bihar, Chattishgarh, Gujarat, Haryana, Himachal Pradesh, J&K, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamilnadu, Uttranchal, Uttar Pradesh and West Bengal have been prepared.



Infestation of major weeds in different states of India

National Weed Herbarium

In the era of globalization and free trade, it is important to quarantine the movement of objectionable weed seeds for which, the knowledge of weed seed identification is a pre-requisite. In this context a project has been undertaken to prepare a key to the identification of the seeds of 100 major weeds of India. Efforts are also being made to develop a national weed herbarium at this centre to fulfill the mandate of acting as a repository of information on weds. Seeds and herbarium of over 140 weed species, from different parts of the country, were collected and deposited in the herbarium.

Preservation of weed seeds

Preservation of 22 *rabi* and *kharif* weeds of NRCWS farm were done in museum jars. The weed specimen contained weeds of confusion with similar morphology among themselves and with their respective crops etc. like different species *Vicia* and *Echinochloa.*

Fifty weed specimens were collected and herbaria prepared. About 485 herbaria received from 10 AICRP-WC centres are being processed for classification and other details. List of 100 most problem weeds from different AICRP Centres have been prepared and some seeds have been collected for planting in the weed germplasm maintenance unit recently prepared.

A record number of 22 extension bulletins both in English and Hindi were broughtout. Two-awareness campaign, two trainings for farmers were conducted and participated, in three *kisan melas*. A total of 39 demonstrations in *rabi*, 25 in *kharif* and 17 on invasive weeds in non-cropped areas were conducted. The details are as under :

Scientists discussing the effect of zero-tillage in wheat on farmers field

Herbicide use under zero tillage in wheat

Field demonstrations were conducted in four locations (1-Mohanea and 3-Kushner villages) to evaluate the performance of herbicides in wheat under zero and conventional tillage conditions. Chlorimuron ethyl + metsulfuran methyl (Almix) at 4 g/ha and 2, 4-D + isoproturon (IPU) (500+500 g/ha) as post - emergence spray (25 DAS) were tested.

Weed flora of the field consisted of *Lathyrus aphaca, Vicia sativa, Chenopodium album, Medicago hispida, Melilotus alba, Avena sp.* (wild oat) and *Phalaris minor*. ZT (zero tillage) effectively reduced the weed population as compared to CT (conventional tillage). Herbicides effectively controlled the weeds as compared to weedy check. The weed control efficiency (WCE) of Almix and 2,4-D+IPU was higher in ZT as compared to CT and saved about Rs. 1500/ha on account of land preparation and around 12-15 hrs. time.

Treatment	No. of Demo	Weed count/m²		Grain yield (kg/ha)		Benefit due to treatment (Rs./ha)	
		ZT	CT	ZT	CT	ZT	CT
Almix (4 g/ha)	2	83	158	3152	3137	4892	4948
2,4-D+IPU 500+500 g/ha)	2	52	153	3159	2994	4860	3971
Weedy check	-	316	377	2324	2300	-	-

On-farm demonstrations in four major *rabi* crops

Crops	Treatments	Weed count /m²	Grain yield kg/ha	Cost of treat. (Rs./ha)	Benefit due to treatment (Rs./ha)
Wheat	Sulfosulfuron 25 g/ha PO	8	5613	1800	1845
	Isoproturon 1000 g/ha PO	5	5588	485	3006
	Farmers' practice	16	5563	1600	1735
	Weedy check	52	5025	-	-
Gram	Pendimethalin 1000g/ha PE	16	1638	1617	5703
	Isoproturon 1000 g/ha PE	14	1588	485	6225
	Farmers' practice	47	1350	1600	2207
	Weedy check	64	1038	-	-
Pea	Pendimethalin 1000g/ha PE	23	1375	1617	453
	Clodinifop 60g/ha PO	10	1430	1875	827
	Farmers' practice	16	1338	1600	045
	Weedy check	35	1195	-	-
Mustard	Pendimethalin 1000g/ha PE	20	1525	1617	1109
	Isoproturon 1000 g/ha PE	16	1513	485	2082
	Farmers' practice	53	1475	1600	461
	Weedy check	146	1320	-	

Weed management in wheat in farmers' fields

A total of 26 demonstrations on weed control technology in wheat were laid out on farmers' fields in 8 different locations of Jabalpur and Sihora Tehsil on sulfosulfuron at 25 g/ha (PO), 2,4-D at 750 g/ha (PO), 2,4-D + IPU at 500+500 g/ha and chlorimuron ethyl metsulfuran methyl (Almix) at 4 g/ha and clodinafop at 60 g/ha. The major weeds of the area were *Lathyrus aphaca, Vicia sativa, Chenopodium album, Medicago hispida, Melilotus alba, Avena sp.* (Wild oat) *and Phalaris minor.* All the treatments effectively controlled the weeds (WCE over 70%) and increased the yield of wheat (32-51%) as compared to farmers' practice. 2,4-D was effective against broad leaved weeds where as mixture of 2,4-D + isoproturon effectively controlled mixed weed flora except Wild oat. Clodinafop gave excellent control of grassy weeds (wild oat and *P. minor*). The maximum benefit due to treatment was obtained from clodinafop fb 2,4-D alone and mixture with IPU.

Control of wild oat in wheat on farmers' fields

Demonstrations were carried out on farmers' fields at Panagar, Khajari, Khiria, Nagna, Amkhera and Sehora blocks of Jabalpur district where farmers do not adopt any management remedy against the wild oat in wheat with single post-emergence application of clodinafop at 60 g/ha 3-4 weeks after sowing involving an expenditure of Rs. 1500/- /ha against an expected amount of Rs. 3500-4000/- required for manual removal.

Weed management in *kharif* crops

Application of fenoxaprop 60 g/h at 30 DAS effectively controlled *Echinochloa colona* in comparison to butachlor and anilofos. Application of 2,4-D, (0.50 kg) or Almix (4 g/ha) one week after fenoxaprop application resulted in broad-spectrum weed control and highest grain yield. Maximum benefit was recorded in fenoxaprop alone fb fenoxaprop + 2,4-D and fenoxaprop + Almix.

Scientists of the Centre visiting the field demonstration

In soybean, 6 field demonstrations were conducted at farmers fields in nearby Jabalpur. The fields were infested with mixed weed flora viz., *Echinochloa colona, Dinebra retroflexa, Cyperus* spp., *Digera arvenisis, Commelina communis and Parthenium hysterophorus.* Results revealed that tank mix application of clorimuron + fenoxaprop gave broad-spectrum weed control and higher benefit.

No. of demons-trations	Treatments (kg/ha)	Weed population (60 DAS)		Grain yield (kg/ha)		Cost of treatment (Rs./ha)	Benefit due to (Rs./ha)
		FP	Treated	FP	Treated		
3	Butachlor (1.5)	154	97	3350	3729	675	1334
3	Anilophos(0.4)	110	83	3723	4113	400	1667
13	Fenoxaprop (0.060) (PO)	225	70	2690	4303	1400	7149
4	Fenoxaprop (0.060) PO followed by 2,4-D (0.5) PO	172	32	2925	4550	1550	7062
2	Fenoxaprop (0.060) PO followed by chlorimuron and metsulfuron (0.4) PO	266	31	2619	4238	1725	6855

PO Post emergence

Glyphosate treated Ipomoea

Non-cropped situation

In non-cropped situation, use of glyphosate and metribuzin showed effective *Parthenium* control.

Application of glyphosate and 2,4-D were effective for the control of *Ipomoea carnea*. Application of glyphosate at 15 ml/litre caused 90% drying of leaves and stems of *Ipomoea carnea*. After 3 weeks of spraying 100% control of *Ipomoea carnea* was observed.

2,4-D treated Ipomoea

Training on weed management

A one day training programme on weed management was organized by the Centre with the help of KVK Madhubani on 30.10.2003 at Madhubani (Bihar) under the Chairmanship of Shri Hukum Dev Narayan Yadav, Hon'ble MoS (Agril) Govt. of India. Solutions to many weed control problems of the farmers were offered the scientists of the Centre during the training.

Several trainings on weed management technology were also imparted to the group of progressive farmers, State Agriculture officials fom time to time who visited NRCWS during the year.

Participation in "off-campus" training programme: The Centre took part in "off campus" training programme organized by Farmers Training Centre (FTC), Deptt. of Agriculture (MP) Jabalpur during March 2004. Lectures were organized on weed management in field crops and scientists interacted with farmers in different villages of Sehora, Majhauli, Patan, Shahpura, Kundam and Bargi tehsils/blocks of Jabalpur district.

Awareness campaign

Awareness campaign on water hyacinth management was organized at Junuani village pond on 31.5.2003. Campaign on management of *parthenium* is the regular activity involving farmers, residents, school children, teachers, NGO's and media persons of Jabalpur with an objective to create public awareness about ill effects and management of this pernicious weed.

Awareness compaign for the management of problem weeds

Kisan Goshties

NRCWS organized *kisan goshti* with the help of Gram Panchayat, progressive farmers, block samiti and NSS student at different places during the year. The Centre also participated in *goshti*-cum-field day on management of *Carthamus oxacantha* organized by AICRP-WC, CSAUA&T, Kanpur from 9-11 February 2004.

Kisan Goshti at Kanpur

Participation in Kisan Melas and Aranyotsava

The Centre participated in state-level *van mela* "*Aranyotsava* 2004" from 6-9 February 2004 organised by Ministry of Forest/State Forest Department (MP) and in the *Kisan Mela* organized by JNKVV, Jabalpur from 13-14 March 2004. Photographs and charts depicting the latest research findings and achievements of NRCWS were displayed. A large number of dignitaries, farmers, students and other entrepreneurs from the state visited the stall and acquired technical know-how on weed management. The extension leaflets, handouts and other publications were distributed among the visitors.

Centre's participation in Aranyotsava Mela

Mass rearing chamber

Distribution of Mexican beetles

Many municipalities, KVKs, farmers and NGOs approached for the beetle for release in their respective areas. NRCWS mass cultured the beetle and about 30,000 adult beetles were supplied as a nucleus culture to different cities and villages for release in those areas. Nucleus culture of beetles was also sent to various centres of All India Coordinated Programme on Weed Control and Krishi Vigyan Kendra (KVKs) in Madhya Pradesh, Orrisa and Chhatisgarh, municipalities, Uttaranchal Pradesh and Maharashtra, NGOs, Research institutes of forestry and many individuals in different parts of country.

Roadside monitoring of maxican beetle distribution on parthenium

Monitoring and impact of *Z. bicolorata* on *parthenium*

The Mexican beetle in Jabalpur and suburb area caused large-scale defoliation of *parthenium* in the 4th year of its release. The spread of these beetles was found in more than 40 km area from the mid point of Jabalpur, which is estimated to be in 1600 sq. km area. However, defoliation of *parthenium* by the beetle varied from place-to-place ranging from 10 to 100%. In some places population build-up was so high that beetle had to search the *Parthenium* plants amidst the crops and devoured it completely. It was estimated that beetles caused 100% control of *parthenium* in about 900ha area in and around Jabalpur by 4th year of its introduction.

Training programmes attended by the staff & the centre

Participant	Programme	Venue and period
Dr. P.J. Khankhane	Design and analysis of experiments in Agricultural Research System	IASRI, New Delhi from 5-25 June 2003
Mr. R.S. Upadhyay	Frontier technology for sustainable production of sesame and niger	Coordinator, Sesamum and Niger at JNKVV, Jabalpur during 15-22 September 2003
Sh. A.K. Shrivastava	New formats of accounts presented by CGA for Central autonomous bodies (NPO)	NIFM, Faridabad, 13-17 October 2003
Dr. B.T.S. Moorthy	Management Development Programme in Agricultural Research	NAARM, Hyderabad, 13-19 November 2003
Sh. R.N. Bharti	ICAR-INFLIBNET for agriculture librarians on networking and e-resources management	INFLIBNET Centre, Ahmedabad, 17-29 November 2003
Dr. V.S.G.R. Naidu	Application of stable isotopes to study the physiological processes for crop improvement	UAS, Bangalore, 2-22 December 2003
Dr. P.J. Khankhane	Soil health and product quality under organic farming	JNKVV, Jabalpur, Jan 22 Feb 11, 2004

AWARDS AND RECOGNITION

Dr. N.T. Yaduraju, Director, NRCWS, Jabalpur has been nominated as representative of the ICAR on the Board of Management of JNKVV Jabalpur for a tenure of three years.

Dr. VSGR Naidu, Scientist was honoured with **SIROHI AWARD** by the Indian Society for Plant Physiology for best research paper published in the Indian Journal of Plant Physiology.

Dr. P.J. Khankhane was honoured with 'Best Participant Prize' during training programme on " Soil health and product quality under organic farming" from Jan 22 Feb 11, 2004 at JNKVV, Jabalpur

B.T.S. Moorthy, J.S. Mishra and R.P. Dubey were awarded the first prize for the poster entitled "An appraisal on the problem of dodder (*Cuscuta* spp.) -an invasive parasitic weed in field crops" in the *National Symposium on Alien Invasive Weeds in India* jointly organized by the Assam Agricultural University and NRCWS at AAU, Jorhat during 27-29 April 2003.The

Winners of ICAR zonal tournament with Director of the Centre

Sh. S.K. Bose and Mr. Veer Singh stood first in Carrom and Chess events, respectively, in the ICAR Zonal Tournament held at CIFE, Mumbai from 5-9 January 2004.

Mr. B. Mishra, Sr. Photographer of the Centre was felicitated by the Chief Minister of Madhya Pradesh for his significant contribution in the field of photography. M.P. Photographic Council, Bhopal on the occasion of World Photography Day, gave this honor to him.

राजभाषा

केन्द्र की राजभाषा कार्यान्वयन समिति के तत्वावधान में 14 सितम्बर से 28 सितम्बर 2003 तक राजभाषा पखवाड़ा मनाया गया । इस कार्यक्रम में सभी वैज्ञानिकों/अधिकारियों एवं कर्मचारियों को हिन्दी में अधिकाधिक कार्य करने हेतु प्रेरित किया गया । इसके अंतर्गत विभिन्न प्रतियोगिताओं जैसे निबंध, शुद्धलेखन, टंकण, वाद-विवाद आदि का आयोजन किया गया जिसमें केन्द्र के सभी वर्गो के कर्मचारियों ने भाग लिया तथा विजताओं कोपारितोषिक वितरण किया गया । इस दौरान आर्ट ऑफ लिविंग पर एक कार्यक्रम भी आयोजित किया गया जिसका संचालन श्री जी. आर. डोंगरें, सचिव, राजभाषा कार्यान्वयन समिति ने किया ।

राजभाषा इकाई द्वारा आयोजित
आर्ट ऑफ लिविंग पर एक कार्यक्रम

ALL INDIA COORDINATED RESEARCH PROGRAMME ON WEED CONTROL

AICRP-Weed Control has been operating in 22 cooperating centers with NRCWS as coordinating centre to undertake researches on location-specific problems. The salient findings of the project during the year are as follows:

Weed survey and surveillance

Severe infestation of *Orobanche* spp. was reported in mustard in Bhiwani, Mahendragarh and Rewari districts of Haryana and adjoining districts of Rajasthan. *Malwa parviflora* was increasing in zero tillage wheat. In post-flood condition and harvest stage of deep water rice, *Hymanachne acutigluma, Oryza rufipogon* and *Sacciolepis interrupta* were most problematic weeds in North Bank Plain Zone of Assam.

At Pantnagar, the population of *Leptochloa chinensis* in rice and *Rumex acetosella* in wheat were increasing. In isoproturon treated wheat plots *Lathyrus aphaca, Melilotus indica* and *Medicago denticulata* were becoming problems. *Merrimia vitifolia* a climber belonging to the family convolvulaceae was seen spreading fast in Western Ghat Regions of the country. Being a climber, it could grow over the tree and bushes and smother them to a great extent. In Western Himalaya, Warm Sub-humid Regions an increase in the density of non-grasses in rice like *Caesulia axillaris* and *Commelina benghalensis* was also reported. *Lathyrus aphaca, Medicago indica* and *M. denticulata* were also reported to be increasing in wheat fields treated with isoproturon.

Integrated weed management in cropping systems

In rice-wheat system, conventional tillage gave higher yield than bed-system. Intercropping of berseem in vacant furrows provided a bonus yield of fodder (146 q/ha) besides suppressing weeds. Zero tillage recorded more grasses than conventional tillage. Soil solarization under sunflower-okra cropping system controlled most of the broadleaved weeds and recorded higher grain yield over stale seedbed and non-solarised plots under semi-arid ecosystem.

Weed management in farming system

Weed management in rice-based farming system conducted at Deccan Plateau revealed that inclusion of fish (rice + fish) in rice culture reduced the weed density by 26% and 38% during the first and second years and addition of *azolla* in rice + fish system further reduced the weed density (39% during the first year and 43% during the second year).

Weed management in specific crops

In direct-seeded rice, Butanil (4 l/ha at 10 DAS), Almix (4g) and fenoxaprop (60 g/ha) were found effective. Intercropping of cowpea and harvesting it for fodder at 30 DAS controlled the weeds effectively in direct-seeded rice in Assam and Bengal Plain Hot Humid Region. In Northern Plain Region, sowing of wheat on raised bed (FIRB) recorded almost similar grain yield (4085 kg/ha) to that obtained under flat system of sowing (3961 kg/ha). The population of *P. minor* was found to be low on raised bed system. Intercropping with berseem in vacant furrows appeared to be promising as the systems provided bonus yield of fodder and helped in reduction of weed seed production. In cotton, pre-emergence application of pendimethalin at 1.50 kg/ha followed by protected spraying of glyphosate (0.5%) gave maximum yield of cotton. Soil solarization gave significantly higher fruit yield of okra as compared to stale seedbed technique and non-soil solarization.

Permanent herbicide trials

Ten years study in rice - wheat system at Northern Plain Region revealed the resurgence of *E. crus-galli* in all the treatments tested. Continuous use of anilofos increased the population of *Caesulia auxillaris* and *Cyperus iria* but provided good control of *Ischaemum rugosum*. In rice-rice systems of Western Ghat Region, in 7th crop herbicide treatment resulted in appearance of *Panicum distachyon*. *Ammania baccifera* was replaced by *Marsilea quadrifolia*.

Biology and management of problem weeds

In Assam, Bengal Plains application of metribuzin 0.2 % was found effective for control of *Parthenium* without affecting the native grasses. In this region the application of glyphosate 1.5 kg/ha or paraquat 0.5 kg/ha, 2,4-D 0.75 kg/ha effectively controlled *Mimosa rubicaulis* complex in the non-cropped areas of the state. Split application of glyphosate provided good control of *Sorghum halepense* while glufosinate ammonium provided good control of *I. cylindrica* in lawn. *Panicum* sp. in place of *C. ceresia* under Punjab conditions had great suppressing potential against *P. hysterophorus*.

Herbicide resistance

Seeds of *P. minor* collected from farmers' fields where isoproturon efficacy was poor and did not show resistance to isoproturon in Himalayas, Sub-humid Region. *P. minor* populations under isoproturon after three years with continuous treatment with alternate herbicides showed resistance to isoproturon again in Northern Plain Zone.

Seed production potential and weed seed bank

Among grassy weeds, higher seed production potential was observed with *E. colona* (2,756 seeds / plant). But *E. crus-galli* contributed for higher weed seed rain of 69,283.2 seeds / m^2 due its higher density under lowland condition. Higher seed production potential of *P. hysterophorus* contributed for the highest weed seed rain of 2, 49,761 seeds/m^2. There was a sharp decline in soil seed bank of *P. minor* from May (after harvest of wheat) to November (before sowing of wheat). It varied from 8.7 to 35.9% of original seed bank at harvest of wheat. Clodinafop, sulfosulfuron and fenoxaprop helped in reducing seed population of *P. minor* as compared to isoproturon and control.

Management of aquatic and parasitic weeds

Application of 1% glyphosate effectively controlled lotus (*Nilumbo* spp.) in canals. *Eichhornia crassipes* could be effectively controlled by applying Algrip 50 g/ha. Post-emergence application of 2,4-D sodium salt 5g+urea 20g/l water effectively reduced the density of *Striga asiatica* in sugarcane.

Herbicide residues

In maize, atrazin 1.0 kg/ha persisted up to 60 DAS and 2.0 kg/ha up-to 80 DAS. There was no effect on subsequent crops. Four years continuous application of butachlor in rice had no residual effect in soil and grain. Residual effect of sulfonyl-urea herbicides showed significant decrease in the population of bacteria and *Azotobactor* after 15 days. Fluchloralin residues were lower at all the intervals under fluchloralin (1.0 kg/ha) applied in combination with 10 t FYM / ha as compared to fluchloralin applied alone in potato field.

Persistence of herbicides in water

In Deccan Plateau Region, persistence of paraquat in water samples showed a declining trend after spray. Nearly 80-90% of applied paraquat degraded with in eight days after application. Ground water samples collected from several tube wells from the fields in Punjab where farmers had applied isoproturon in wheat under rice-wheat system for the last several years did not indicate any isoproturon residue.

ROLE OF WOMEN IN WEED MANAGEMENT

Weeding being performed by the farm-women

Farm-women being shown the improved weeding tools

There has been a perceptible increase in participation of women in agriculture especially in weed management due to a rise in seasonal demand for labour for operations traditionally performed by women and due to an increase in employment of men in non-agricultural activities. The rural women-folk have diverse responsibilities as head of farm household, member of family and are forced to carry out about 70 % farm work. The farm operations like uprooting of rice nursery and its transplanting, weeding, harvesting, threshing and winnowing of crop mainly involve women. Manual and mechanical weeding are still the most commonly used methods of weed control in the country. Hand weeding is highly laborious, time taking and involves drudgery which is mostly performed by women. Appropriate technologies in the area of weed management through mechanical weeders and chemical spraying make the farm women's tasks easier, more enjoyable, less burdensome, more profitable and more productive without displacing them from the labour market, besides allowing them to pursue other productive works. In order to ensure proper participation of women in appropriate technology, they need specific training exposure.

In view of the importance of the involvement of women in weed management, a training programme was organized at the National Research Centre for Weed Science, Jabalpur on 1st September 2003. About 60 farmwomen from nearby villages participated in the training who were exposed to various aspects of improved weed management technologies. They were also appraised of various weeding tools specially developed by the Centre which can easily be operated by the farmwomen and effectively reduce the drudgery.

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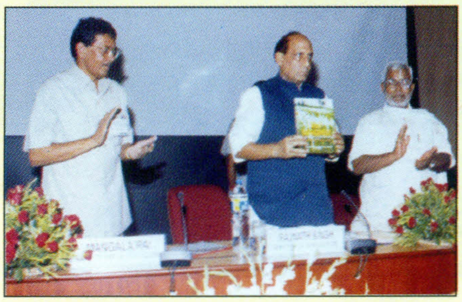

Shri Raj Nath Singh, Hon'ble Union Minister of Agriculture releasing a books on "Herbicide Use-Guidelines" authored by Dr. N.T. Yaduraju, Director, NRCWS and "Weed Management" edited by V.N. Saraswat, V.M. Bhan and N.T. Yaduraju on the occasion of Directors meeting during 29-31 July 2003. Also seen in the picture are Shri Hukumdeo Narain Yadav, Minister of State for Agriculture and Dr. Mangala Rai, Secretary DARE and DG, ICAR

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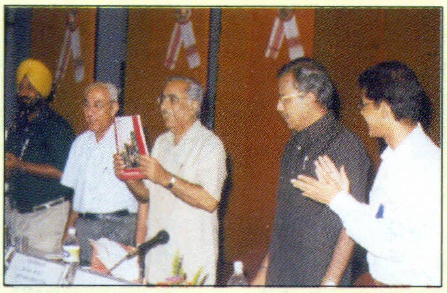

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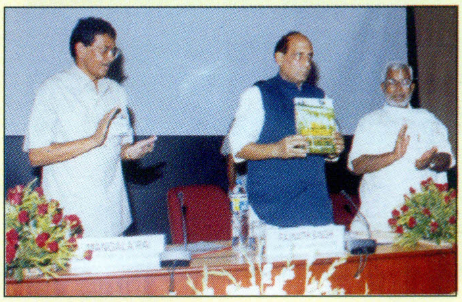
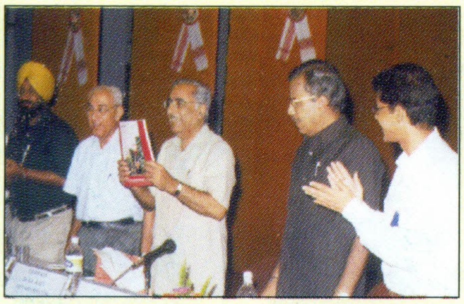


Shri Raj Nath Singh, Hon'ble Union Minister of Agriculture releasing a books on "Herbicide Use-Guidelines" authored by Dr. N.T. Yaduraju, Director, NRCWS and "Weed Management" edited by V.N. Saraswat, V.M. Bhan and N.T. Yaduraju on the occasion of Directors meeting during 29-31 July 2003. Also seen in the picture are Shri Hukumdeo Narain Yadav, Minister of State for Agriculture and Dr. Mangala Rai, Secretary DARE and DG, ICAR

Review articles



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ON-GOING RESEARCH PROJECTS

Code	Projects	Principal Investigator
A	**Herbicide as a tool in weed management**	
1101	Testing of new molecules	Dr. N. T. Yaduraju
1201	Long term effects of herbicides in cropping systems	Dr. V.P. Singh
1301	Influence of herbicides on soil micro-flora, soil fertility and productivity	Dr. K.K. Barman
1401	Improving efficacy of herbicides through herbicide mixture, adjuvant etc	Dr. Anil Dixit
1501	Studies on herbicide application techniques	Er. H. S. Bisen
B	**Weed biology and eco-physiology**	
2101	Biology of major weeds	Dr. A.K. Gogoi
2201	Weed flora shift in cropping systems	Dr. V.P. Singh
2301	Eco-physiology of crop-weed competition	Dr. J.S. Mishra
2401	Weed herbarium and collection, conservation and utilization of weed biodiversity	Dr. D. Swain
2501	Effect of nutrient supply on crop-weed competition	Dr. M.B.B. Prasad Babu
2601	Germination, dormancy and ageing of weed seeds	Dr. D.K. Pandey
C	**Development and evaluation of integrated weed management techniques /practices**	
3101	Role of weed competitive crop cultivars in IWM	Dr. B.T.S. Moorthy
3201	Design, development and evaluation of mechanical weeding tool as a component of integrated weed management techniques and practices	Er. H.S. Bisen
3301	Effect of tillage and weed control measures on weed dynamics in different cropping systems	Dr. J.S. Mishra
3401	Role of intercrops and cover crops in weed management	Dr. R.P. Dubey
3501	Studies on effect of crop residue management on weeds in rice-wheat cropping system	Dr. P.J. Khankhane
3601	Evaluation of improved weed control technologies on farmers' fields	Dr. P.K. Singh
D	**Bio-pesticides and biocontrol of weeds**	
4101	Herbicidal activity of plants and their constituents	Dr. D.K. Pandey
4201	Optimizing *Z. bicolorata* release as an augmentative measure for the control of *Parthenium hysterophorus*.	Dr. Sushilkumar

LINKAGES AND COLLABORATION

MoA signed with JNKVV, Jabalpur

NRCWS entered into a Memorandum of Agreement (MoA) for collaboration in research and education with JNKVV, Jabalpur on 27 May 2003. This will enable scientists of NRCWS in teaching and guiding the university students in their research at the Centre. Vice-Chancellor, JNKVV explained the scope and benefits of MoA for the organizations.

The Centre has an effective collaboration with SAUs through AICRP-WC program operating at 22 Centres. With regular group meetings workshops and visits, it helps in identifying weed problems in different agro-climatic zones in the country and suggests a plan of action for their management.

The Centre also has collaboration with several ICAR Institutes such as CIAE, Bhopal, IARI, New Delhi, PDBC, Bangalore, PDCSR, Modipuram, NBSS&LUP, Nagpur, NCAP, New Delhi etc. It is proposing to strengthen international collaboration with CABI, IRRI, CIMMYT and other universities in USA, UK and Australia.

Research scholars under dissertation

Being a nodal agency for research and training in the field of weed science and a repository of information in weed science in the country, NRCWS offered research and training to the 17 research scholars and provided expertise and consultancy to the staff and students of SAUs, ICAR Institutes, NGOs, herbicide industries etc.

Externally-funded projects

The following AP Cess funded projects approved during the period under report :

Sl	Projects	Place	Period	
			From	Upto
1	Effect of elevated atmospheric CO_2 on crop-weed interactions	NRCWS	2004	2007
2	Determination of the role of weeds in epidemic and perpetuation of economically important plant viruses Lead centre - IARI, New Delhi Co-centre - NRCWS, Jabalpur	IARI & NRCWS	2004	2007

RAC, SRC AND IMC MEETINGS

QRT Meeting

The QRT of AICRP-WC (1997-2001) constituted with Dr. H.K. Pande, Former Director, CRRI as Chairman and Dr. V.M. Bhan, Ex. Director, NRC WS; Dr. L.S. Brar, President, Head Agronomy, PAU; Dr. Gita Kulshrestha, Professor, IARI; Dr. S.P. Singh, Former Director, PDBC; Dr. R.K. Malik, Head, Agronomy, CCSHAU as members and Dr. A.K. Gogoi, Pr. Scientist, NRCWS as Member Secretary visited the cooperating centres and critically reviewed the research activities undertaken by them. The first meeting was held at ICAR on March 24, 2003 and the Chairman and DDG (NRM) disussed the plan of activities of ICAR in the context of X plan formulation. The committee reviewed the work of different centres at CSAUAT,; UAS,; OUAT, and HPKV. The committee also visited PAU, CCSHAU, AAU, VB, ANGRAU, MAU, UAS, DBSKKV and RAU and reviewed the research activities.

QRT reviewing the work of co-ordinating ceters

The QRT after reviewing noted the negative impact of weeds on agriculture and environment. The weed problems are also changing and increasing due to the use of number of high cost production inputs in the agricultural systems. The committee strongly recommended that the weed science research should continue and more efforts should be made to strengthen the activities of the NRCWS and AICRP-Weed Control of the country. The committee has recommended organizational, infrastructure, scientific and policies for the improvement of the activities of the project.

Research Advisory Committee (RAC) Meeting

A meeting of the RAC for the Centre comprising of Dr. J.S. Kolar (Chairman), Dr. V.M. Bhan, Dr. N.T. Yaduraju, Dr. David N. Sen, Dr. (Mrs.) Gita Kulshrestha, Shri Raj Kumar Prasad and Shri Kishori Mahto (all members) and Dr. A.K. Gogoi (Member secretary) was held from 27-28 January, 2004. The committee visited the field and laboratory experiments. They critically evaluated the research activities of the Centre and gave valuable suggestions for improvement of the programmes for the coming year.

RAC Meeting

Staff Research Council (SRC)

The SRC meeting was convened on July 5-6 and 11, 2003, under the chairmanship of Dr. N.T. Yaduraju, Director to review the results of on-going research projects and to consider new project proposals. All the scientists presented their research achievements of 2002-03.

Institute Management Committee (IMC)

The meeting of the IMC was held on 29 March, 2004 at NRCWS, Jabalpur under the chairmanship of Dr. N.T. Yaduraju, Director. The members present were Shri Raj Kumar Prasad and Shri Kishori Mahto (non-official members), Dr. B.T.S. Moorthy, Pr. Scientist; Shri. O.N. Tiwari, IJSC Secretary; Shri. A.K. Shrivastava, AF&AO and Shri. Balwant Rai, AAO. The progress of developmental activities and infrastructure built-up was reviewed.

PARTICIPATION OF SCIENTISTS IN SEMINARS, SYMPOSIA ETC

Participants	Conference / Symposium	Venue & Date
N.T. Yaduraju, A.K. Gogoi, D.K. Pandey, D. Swain, P.K. Singh, V.P. Singh, R.P. Dubey, K.K. Barman, J.S. Mishra, Sushilkumar, Anil Dixit, M.B.B. Prasad Babu, V.S.G.R Naidu, M.S. Raghuvanshi, A.K. Shrivastava, Sandeep Dhagat, O.N. Tiwari, N. Mishra, K. Vishwakarma, Sushil Rajput, Ms. N.G. Ansari	Annual Group Meeting of AICRP-WC and National Seminar on Alien Invasive Weeds in India	AAU, Jorhat 25-26 Apr, 2003
Dr. N.T. Yaduraju	National Seminar on Opportunities and Potentials of Spices for Crop Diversification	JNKVV, Jabalpur 19-21 January 2004
	IVth Workshop of NATP on Accelerating the Adoption of Resource Conservation Technologies for Farm Level Impact on Sustainability of Rice-Wheat Systems of Indo-Gangetic Plains	PDCSR, Modipuram 6-7 Jun, 2003
	Directors' Conference	ICAR, New Delhi 29-31 Jul, 2003
	Reconstituted Task Force on Bio-Pesticides and Crop Management	DBT, New Delhi 11 Aug, 2003
	XVIII meeting of Regional Committee - VII	CICR, Nagpur 8-9 Sept, 2003
	IMC Meeting of CIAE, Bhopal	CIAE, Bhopal 12 Nov, 2003
	Group Meeting of AICRP-Cropping System	UAS, Bangalore 21-22 Nov, 2003
	International Symposium on Ecology of Biological Invasions	Delhi University, New Delhi 4-6 Dec, 2003
	Project Screening Committee Meeting	ICAR, New Delhi 9 Dec, 2003
	Workshop on *Lantana camara* Problems and Prospects	HESCO, Dehradun 10-11 Feb, 2004
	X-Plan EFC Clearance Meeting	ICAR, New Delhi 24 Feb, 2004
Dr. D.K. Pandey	International Conference on Eco-Restoration	ICFRE, Dehradun 14-21 Oct, 2003
	91st Indian Science Congress	Punjab University, Chandigarh 3-7 Jan, 2004
Dr. V.P. Singh	A field-day on Participatory Technology Development for Controlling *Carthamus oxyacantha* Bieb A Troublesome Weed in Jalaun Area of UP	AICRP-WC, Kanpur from 9-11 February 2004 at Jalaun (UP)
Dr. J.S. Mishra	A Meeting on Discussion on Infrastructure Requirements for Seed Production in Agricultural Crops and Fisheries	NBPGR, New Delhi 24-25 February 2004
Dr. Sushilkumar	National Workshop on Regional Strategy for Plant Conservation	TFRI, Jabalpur from 26-27 February 2004
Dr. J.S. Mishra and Manish Bhan	National Symposium on Pulses for Crop Diversification and NRM	IIPR, Kanpur, 20-22 December 2003
Dr. A.K. Gogoi	Review Meeting of IPM Projects	PDBC, Bangalore on 13 December 2003

WORKSHOPS, SEMINARS, TRAINING PROGRAMMES ORGANIZED

Group Meeting of AICRP on Weed Control

Annual Group Meeting to AICRP-WC being inaugurated at AAO Jorhat

A two-day Annual Group Meeting of All India Coordinated Research Programme on Weed Control was held at Assam Agricultural University (AAU), Jorhat from 25-26 April 2002. About 100 weed scientists besides personnel from pesticide industry participated in the deliberations. During the, Dr. G.L. Kaul, Vice Chancellor, AAU, Jorhat, inaugurated the function. Dr. N.T.Yaduraju, Director, NRCWS, presented the salient research highlights of the AICRP-WC for the year 2002-03. The Principal Investigators of different AICRP-WC centres presented their research findings of the previous year and the research agenda for the next year was finalized. Several publications viz., Annual Report of AICRP-WC 2002-03,Weed Control Recommendations, Local Name of Weeds, Chemical Control of Weeds, Photo Album on *Orobanche* were released on the occasion.

National Seminar on Alien Invasive Weeds in India

Delegates at Kaziranga Park

A National Seminar on "Alien Invasive Weeds in India" was organized by Assam Agricultural University in association with National Research Centre for Weed Science form 27 to 29 April 2003 at Jorhat. The seminar was organized to discus the current status of alien invasive weeds in India and develops plans to manage them. The seminar was inaugurated by Dr. G.L. Kaul, Vice Chancellor, AAU, Jorhat. Dr. V.M. Bhan, former Director, NRCWS, Dr. S.Sankaran, Former Vice Chancellor, TNAU, Dr. S.V.R. Shetty, Sr. Consultant, IARSD, Bangalore, Dr. K.M. Bujarbaruah, ICAR Research Complex for NEH Region, Barapani, Dr. A.K. Pathak, Director Research, AAU, Jorhat, Dr. Ravindra, Director, PDBC, Bangalore were the other dignitaries who attended the function. Dr. N.T. Yaduraju, Director, NRCWS presented an overview of alien invasive weeds. Fourteen lead papers and posters were presented during the seminar on the agro-biology and management of alien invasive weeds occurring in different parts of the country.

Training to Farm-Women

Training to farm women in Weed Management

A training programme on role of farmwomen in the area of weed management was organized at the Centre on 1st September, 2003. About 60 farmwomen from nearby villages participated in the training.

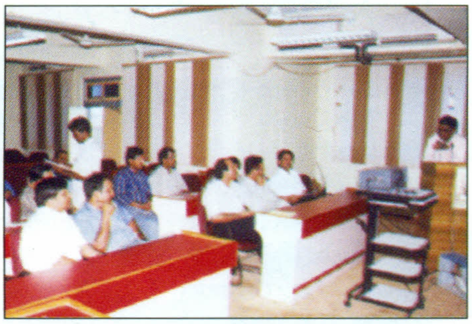
Campaign on parthenium eradication

As a part of ongoing *Parthenium* eradication campaign, all the staff members of the Centre made '*Shramdan*' at the M.P. Housing Board Colony, Maharajpur, Jabalpur on 08-08-2003, to make people aware of the problems caused by this dangerous weed. Residents of the colony also actively participated who were told about the ill effects of this weed on human health, animals and the environment.

Parthenium eradication campaign

Training for technical assistants

A four-day training programme on practical aspects and research methodologies was organised by Agronomy Section at the Centre during 7-10 October 2003. The objective of the programme was to upgrade the skills of technical assistants of the Centre with regard to practical aspects of field experimentation. The programme was coordinated by Dr. B.T.S. Moorthy, Pr. Scientist and I/C Agronomy Section of the Centre.



Training programme for centre's technical assistants on prectical aspects

Workshop on photography

A two-day workshop on "Fundamental knowledge of Photography" was organized by the Social Sciences and Transfer of Technology section of the Centre from August 13 to 14, 2003 to make the staff aware of the basics tips of photography. All the scientists and other staff members attended the workshop. Sri Basant Mishra, Sr. photographer and Sri Mukesh Bhatt, Artist of the Centre gave valuable information on various aspects of photography including digital photography.

Monthly Seminar at the Centre

The following staff members delivered the seminars during 2003-04

Speaker	Topic	Date
Dr. V.S.G.R. Naidu	Weeds in high CO2 environment	8.4.2003
Dr. N.T. Yaduraju	Herbicide resistant crops: a new tool in weed management	18-7-2003
Er. H.S. Bisen	Studies on different spray application techniques for herbicide use in field conditions	19-7-2003
Dr. K.K. Barman	Know your laboratory instruments	19-7-2003
Dr. D.K. Pandey	Seed ageing-conflicting interest in crop production	19-7-2003
Dr. V.P. Singh	Soil solarization-a non pesticidal technique of weed management	23-8-2003
Dr. P.K. Singh	A study on socio-economic knowledge and adoption level of farmers towards weed management practices in Sihora block of Jabalpur	6-9-2003
Mr. K. Vishwakarma	Water quality and pollutants	6-9-2003
Dr. R.P. Dubey	ITK in pest management with special reference to weeds	27-9-2003
Dr. Aradhana Upadhyay	Biological control of weeds using plant pathogens	27-9-2003
Mr. Manish Bhan	Weed, rice and poor people in South Asia	31-1-2004
Ms. Nasreen G. Ansari	Significance of herbicide residue analysis	28-2-2004
Mr. Sushil Rajput	Wroogles: A new weed search tool for explorers	28-2-2004
Ms. Poonam Chandla	Threat of an IED	28-2-2004
Mr. M. Suryanarayana	Germination and related investigation on *Phalaris minor* weed seed	17-3-2004
Mr. P. Venkatnarasaih	Biochemical parameters in transgenic and conventional mustard	17-3-2004
Dr. P.J. Kankhane	Organic farming: Philosophy and practice	27-3-2004
Dr. M. B. B. Prasad Babu	Impact factor - A Tool to evaluate Journal quality	27-3-2004

Lectures delivered outside

The following lectures were delivered

Scientist	Subject	Venue and date
Dr. N.T. Yaduraju	Maximizing Productivity and Profitability of Sesame through IWM	JNKVV, Jabalpur 27 Sept, 2003
	Alien Invasive Weeds in India - An overview at International Symposium on Ecology of Biological Invasions	Delhi University, New Delhi 4-6 Dec, 2003
	Use of herbicide for Lantana Management	HESCO, Dehradun 10-11 Feb, 2004
	Applications of Biotechnology in Weed Management	DBT, New Delhi 13 Feb, 2003
	Integrated Weed Management in Oilseeds and Pulses	NCIPM, New Delhi 6 Dec, 2003
	Biological Control of Weeds	JNKVV, Jabalpur 4 Feb, 2004.
Dr. J.S. Mishra	Integrated Weed Management in Cotton, Rice and Vegetables	NCIPM, New Delhi 27 Sept, 2003
Dr. B.T.S. Moorthy	Scenario of Weed Management in India	DOR, Hyderabad 12 Nov, 2003
Dr. Anil Dixit	Weed Management in Organic Farming	JNKVV, Jabalpur 15 Jan, 2004
Dr. Anil Dixit	Weed management in Oilseed Crops on 4-2-2004 at	Farmers Training Centre Jabalpur, 4 Feb, 2004
Dr. V.P. Singh	Weed Management in Sugarcane	Farmers Training Centre, Jabalpur, 23 Feb, 2004

Training to research scholars 2003-04

The following M. Sc. students from different universities completed their research project work under the guidance of the scientists of the Centre during the year.

Sl.	Research scholars	Period		Supervisors
		From	To	
1	Ms. Shivendra Chaurasia, APS University, Rewa	Aug, 2003	Oct, 2003	Dr. K.K. Barman
2	Ms. Nisha Singh, APS University, Rewa	Aug, 2003	Oct, 2003	Dr. A.K. Gogoi
3	Ms. Pooja Singh, APS University, Rewa	Aug, 2003	Oct, 2003	Dr. D.K. Pandey
4	Ms. Pooja Pandey, APS University, Rewa	Aug, 2003	Oct, 2003	Dr. D. Swain
5	Ms. Ranu Dwivedi, APS University, Rewa	Aug, 2003	Oct, 2003	Dr. Sushilkumar
6	Ms. Kajal Jain, Model Science College, Jabalpur	05.11.2003	31.12.2003	Dr. Sushilkumar
7	Ms. Monica Dubey, Model Science College, Jabalpur	05.11.2003	31.12.2003	Dr. K.K. Barman
8	Ms Preeti Shrivas, Model Science College, Jabalpur	05.11.2003	31.12.2003	Dr. J.S. Mishra
9	Ms. M. Rajni Chettiar, Model Science College, Jabalpur	05.11.2003	31.12.2003	Dr. D. Swain
10	Ms. Seema Chauhan, Model Science College, Jabalpur	05.11.2003	31.12.2003	Mr. Chandra Bhanu
11	Mr. P. Venkata Narasaiah, J.J. College of Arts & Science, Pudukkottai	Jan, 2004	Mar, 2004	Dr. Sushilkumar
12	Mr. Spartcus Katta, JJ College of Arts & Science, Pudukkottai	Jan, 2004	Mar, 2004	Dr. D. Swain
13	Mr. B. Santoshkumar, JJ College of Arts & Science, Pudukkottai	Jan, 2004	Mar, 2004	Dr. N.T. Yaduraju
14	Mr. Maniram Vishwakarma, RDVV, Jabalpur	Jan, 2004	Jun, 2004	Dr. K.K. Barman
15	Ms. Arpana Kureel, RDVV, Jabalpur	Jan, 2004	Jun, 2004	Dr. K.K. Barman
16	Ms. Monika Shaklya, RDVV, Jabalpur	Jan, 2004	Jun, 2004	Mr. Chandra Bhanu
17	Ms. Pooja Ray, Part Time Research Scholar	Jan, 2003	Mar, 2004	Dr. Sushilkumar

Guest Lecture

Dr. P.K. Mukharjee, Lecturer, UBKV, Coochbehar, WB delivered a lecture on " Weed Scenario in Terai and Hill Region of West Bengal" on 4-3-2004.

Radio talks

Dr. M.S. Raghuvanshi - Weed management in *rabi* crops at 7.00pm on 15.10.2003

Dr. N.T. Yaduraju - Weed management aired by VoA, Washington, DC on 26.10.2003

हिन्दी कार्यशाला

केन्द्र में तकनीकी वर्ग के कर्मचारियों को अधिक से अधिक हिन्दी में कार्य करने के लिए राजभाषा कार्यान्वयन समिति के तत्वाधान में 25 से 26 मार्च, 2004 तक दो दिवसीय हिन्दी कार्यशाला का आयोजन किया गया । जिसमें केन्द्र के तकनीकी वर्ग के सभी अधिकारियों/कर्मचारियों ने भाग लिया । निदेशक डॉ. एन. टी. यदुराजू ने इस कार्यशाला के आयोजन पर प्रसन्नता व्यक्त करते हुये आशा की कि राजभाषा कार्यान्वयन समिति भविष्य में केन्द्र में कार्यरत अन्य वर्गो के कर्मचारियों हेतु भी इस तरह की कार्यशाला आयोजित करती रहेगी ।

इस कार्यशाला में हिन्दी राजभाषा की उत्पत्ति, विकास एवं संवैधानिक स्थिति, राजभाषा कार्यान्वयन में परिषद के विभिन्न संस्थाओं में किये जा रहे प्रयास, हिन्दी की प्रमाणिक वर्तनी एवं राजभाषा में संगणक (कम्प्यूटर) का ज्ञान, आदि विषयों पर श्री जी. आर. डोंगरे, डॉ. व्ही. पी. सिंह, डॉ. जे. एस. मिश्रा एवं श्री संदीप धगट द्वारा प्रतिभागियों को जानकारी दी गयी ।

DISTINGUISHED VISITORS

Sl.	Visitors	Date
1	Dr. G.S. Kaushal, Director of Agriculture (MP)	16.09.2003
2	Dr. J.L. Bose, Agriculture Commissioner (MP)	19.01.2004
3	Dr. V.M. Bhan, Former Director, NRCWS, Jabalpur	19.01.2004, 27.01.2004
4	Dr. D.P. Singh, Vice Chancellor, JNKVV, Jabalpur	19.01.2004
5	Dr. J.S. Kolar, DES, PAU, Ludhiana	27.01.2004
6	Dr. (Mrs.) Gita Kulshrestha, Professor, IARI, New Delhi	27.01.2004
7	Dr. David N. Sen, Retd. Professor, University of Jodhpur	27.01.2004
8	Dr. A.S. Tiwari, Former Vice-Chancellor, JNKVV, Jabalpur	30.01.2004

Dr. Kolar, Chairman, with other members of RAC visiting the field experiments

Dr. J.L. Boss, Agricultural Production Commissioner visiting the exhibition hall of the centre

PERSONALIA (as on 31.03.2004)

Director

Dr. N.T. Yaduraju

Scientific

Dr. B.T.S. Moorthy	Pr. Scientist (Agro.)
Er. H.S. Bisen	Pr. Scientist (Ag. Engg.)
Dr. A.K. Gogoi	Pr. Scientist (Agro.)
Dr. D.K. Pandey	Sr. Scientist (Pl. Physiol.)
Dr. K.K. Barman	Sr. Scientist (Soil Sci.)
Dr. V.P. Singh	Sr. Scientist (Agro.)
Dr. Sushilkumar	Sr. Scientist (Entomo.)
Dr. R.P. Dubey	Sr. Scientist (Agro.)
Dr. J.S. Mishra	Sr. Scientist (Agro.)
Dr. Anil Dixit	Sr. Scientist (Agro.)
Dr. D. Swain	Sr. Scientist (Econ. Botany)
Dr. P.K. Singh	Sr. Scientist (Agril. Extn.)
Dr. M.B.B. Prasad Babu	Scientist (SS) (Soil Sci.)
Dr. P.J. Khankhane	Scientist (SS) (Soil Sci.)
Dr. Shobha Sondhia	Scientist (Residue Chem.)
Dr. V.S.G.R. Naidu	Scientist (Economic Botany)
Sh. Chandra Bhanu	Scientist (Pl. Pathology)

Administration, Finance and Accounts

Sh. Balwant Rai	Asstt. Admn. Officer
Sh. A.K. Shrivastava	Asstt Fin & Acc Officer
Smt Nidhi Sharma	Sr. Steno
Sh. J.P. Kori	Sr. Clerk
Sh R. Hadge	Sr. Clerk
Sh. T. Lakhera	Sr. Clerk
Sh. B.P. Uriya	Jr. Clerk
Sh. Francis Xavier	Jr. Clerk
Sh. A.K. Bhowal	Jr. Steno
Sh. M.K. Gupta	Jr. Steno

Technical

Dr. M.S. Raghuwanshi	T-6 (Technical Officer)
Sh. R.S. Upadhyay	T-6 (Farm Manager)
Sh Mukesh Bhatt	T-5 (Artist-cum-Photographer)
Sh. S. Dhagat	T-5 (Technical Officer)
Sh B. Mishra	T-5 (photographer)
Sh V.K.S. Meshram	T-5 (Artist)
Sh G.R. Dongre	T-5 (Draftsman)
Sh O.N. Tiwari	T-4 (Tech. Asstt)
Sh M.P. Tiwari	T-II-3 (Mechanic)
Sh Pankaj Shukla	T-II-3 (Tech. Asstt)
Sh. R.N. Bharti	T-II-3 (Librarian)
Sh S.K. Parey	T-II-3 (Tech. Asstt)
Sh J.N. Sen	T-II-3 (Tech. Asstt)
Sh. K.K. Tiwari	T-II (Field Asstt)
Sh. S. K. Tiwari	T-II (Field Asstt)
Sh. S.K. Bose	T-II (Field Asstt)
Sh. G. Vishwakarma	T-II (Field Asstt)
Sh. Ajay Pal Singh	T-II (Field Asstt)
Sh. V. K. Raikwar	T-I (Field Asstt)
Sh. R.K. Meena	T-I (Field Asstt)
Sh. M.K. Meena	T-I (Field Asstt)
Sh. Premlal	T-II (Driver)
Sh. D.K. Sahu	T-II (Driver)
Sh. B. Prasad	T-II (Driver)
Sh. Sebasten	T-I (Driver)

Supporting

Sh. Veer Singh	Messenger (SSG-II)
Sh. A.K. Tiwari	Messenger (SSG-I)
Sh. Shiv K. Patel	Messenger (SSG-I)
Sh. Pyare Lal	Messenger (SSG-I)
Sh. Sukha Singh	Messenger (SSG-I)
Sh. S.L. Koshta	Lab. Attendant (SSG-I)
Sh. J.P. Dahiya	Lab. Attendant (SSG-I)
Sh. Madan Sharma	Lab. Attendant (SSG-I)
Sh. J. Vishwakarma	Lab. Attendant (SSG-I)
Sh. Raju Prasad	Farm Mazdoor (SSG-II)
Sh. Jagoli Prasad	Farm Mazdoor (SSG-II)
Sh. Jagat Singh	Farm Mazdoor (SSG-II)
Sh. C.L. Yadav	Farm Mazdoor (SSG-II)
Sh. Anil Sharma	Farm Mazdoor (SSG-I)
Sh. Ram Kumar	Farm Mazdoor (SSG-I)
Sh. Naresh Singh	Farm Mazdoor (SSG-I)
Sh. Gajjulal	Farm Mazdoor (SSG-I)
Sh. S.C. Rajak	Farm Mazdoor (SSG-I)
Sh. Rajesh	Security Gaurd (SSG-I)
Sh. Gangaram	Security Gaurd (SSG-I)
Sh. Santosh Kumar	Security Gaurd (SSG-I)
Sh. Santlal	Security Gaurd (SSG-I)
Sh. Mahendra Patel	Security Gaurd (SSG-I)